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AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

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1870.

MISSOURI
BOTANICAL
GARDEN.

"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

"................ per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hìc carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 31. JULY 1870.

I.—*The Ostracoda and Foraminifera of Tidal Rivers.* By GEORGE STEWARDSON BRADY, C.M.Z.S., and DAVID ROBERTSON, F.G.S. *With an Analysis and Descriptions of the Foraminifera*, by HENRY B. BRADY, F.L.S.

[Plates IV.–X.]

Part I.

THAT the stagnant water and mud of salt marshes support a peculiar group of Microzoa has for some time past been well known, though the subject has received the attention of but few naturalists. The number of species inhabiting these localities, however, is probably very small, comprising among Foraminifera, chiefly *Polystomella striatopunctata*, Fichtel & Moll, a *Miliola* hitherto confused with *Quinqueloculina agglutinans*, D'Orbigny, *Trochammina inflata*, Montagu, *Nonionina depressula*, Walker & Jacob;—amongst Copepoda, *Temora velox*, Lilljeborg, *Tachidius brevicornis* (Müller), *Dias longiremis*, Lilljeborg, *Cyclops æquoreus*, Fischer, *C. Lubbockii*, Brady, *Dactylopus tisboides*, Claus, and *Delavalia palustris*, Brady. The Ostracoda are represented almost exclusively by *Cytherea castanea*, G. O. Sars, a smooth form of *Cytheridea torosa* (Jones), *Loxoconcha elliptica*, Brady, and more rarely by *Cypris salina*, Brady, and *Cypridopsis aculeata*, Lilljeborg*.

* See 'Natural History Transactions of Northumberland and Durham,' vol. iii. part 1, "On the Crustacean Fauna of the Salt-Marshes of Northumberland and Durham."

Probably more extended investigation may add to the number of species, but it is evident that the fauna of salt marshes is a very restricted one.

That of river-estuaries, on the contrary, embraces, amongst the Microzoa to which we now refer, a very large number of species, some of which are evidently derived from the fresh-water side, some from the sea, whilst others seem to haunt exclusively water of a more or less brackish character. It is probable, however, that a few examples of purely freshwater or marine type which have occurred sparingly in estuarine situations may have been merely dead shells, washed into the places where they were found either by tides or river-currents. In this class we may reckon, for example, such species as *Cythere abyssicola*, *C. finmarchica*, and probably some of the Cyprides. Out of about ninety species of Ostracoda observed in gatherings taken from river-estuaries, twelve may be looked upon as having marked brackish proclivities; so that, were we to meet with their shells in considerable numbers in any fossiliferous deposit, we should at once infer that the strata must have been produced in water subject more or less to marine influences. Of this group the principal members are *Cythere castanea*, G. O. Sars, *Cytheridea torosa* (Jones) and its varieties, and *Loxoconcha elliptica*, Brady; scarcely less marked in their preference for brackish water are *Cypris salina*, Brady, *Cypridopsis obesa*, B. & R., *C. aculeata* (Lilljeborg), *Potamocypris fulva*, Brady, *Cythere gibbosa*, B. & R., *Cythere porcellanea*, Brady, *Loxoconcha pusilla*, B. & R., *Cytherura flavescens*, Brady, *C. Robertsoni*, Brady, *C. cellulosa* (Norman), and *Paradoxostoma Fischeri*, G. O. Sars.

Of species commonly resident in fresh water we notice twelve, the most frequent of which are *Cypris lævis*, Müller, *compressa*, Baird, *gibba*, Ramdohr, *Candona candida*, Müller, *lactea*, Baird, and *Limnicythere inopinata* (Baird); while of those usually found in the sea, but not unfrequently spreading plentifully up into estuarine localities, we may name *Cythere pellucida*, Baird, *tenera*, Brady, *albomaculata*, Baird, *viridis*, Müller, *villosa* (G. O. Sars), *Xestoleberis aurantia* (Baird), *Loxoconcha tamarindus* (Jones), *Cytherura nigrescens* (Baird), *cuneata*, Brady, *striata*, G. O. Sars, *angulata*, Brady, *Cytherideis subulata*, Brady, *Paradoxostoma variabile* (Baird), *abbreviatum*, G. O. Sars, and *ensiforme*, Brady. The total number of Ostracoda known to us as inhabiting tidal rivers and their estuaries, excluding those found in the Norfolk district, of which we shall speak separately, is eighty-six.

From this enumeration and from the accompanying table, it will be seen that the genera *Cytherura* and *Paradoxostoma*

(perhaps also, to a smaller extent, *Loxoconcha*) may be considered especially littoral or estuarine in habitat; the elongated subsigmoid forms of *Cythere* (typified by *C. pellucida*) come also under the same category.

The situations which seem to be most favourable to the growth and multiplication of these animals are quiet sheltered pools which are never left entirely dry by the tide, are unswept by strong currents, and thus able to retain permanently a bed of soft mud. Many species there are, of course, which prefer different conditions; but it is in such localities that we find our gatherings richest, both as to number of individuals and variety of species. A remarkably fine gathering, taken from a place such as we have described is that from the river Blyth (Northumberland), which contained thirty-eight species of Ostracoda and thirty-eight of Foraminifera. Budle Bay, on the same line of coast, with a harder bottom and more subject to the wash of the sea, and also with much less admixture of fresh water, contained, as shown in our gathering, only twenty-six species of Ostracoda and thirty-six of Foraminifera; while the river Coquet and the Warn burn, with much harder beds, stronger currents, and but little admixture of salt water, gave respectively ten and six species of Ostracoda, and no Foraminifera.

The Entomostraca of the tidal waters of Norfolk, Suffolk, and the Cambridge fen-district constitute so remarkable a group that it seems best to speak of them separately; and in so doing we shall call the area to which we refer the *East-Anglian district*, understanding by that term the whole tract drained by the rivers Nene, Cam, Bure, Yare, and Waveney. The drainage-tract of the adjoining rivers on the south, Ald, Deben, Stour, &c., is separated by rising ground, and appears to be zoologically distinct; but whether the more northern fen-district of Lincolnshire be likewise distinct, we have not yet had the opportunity of examining. If, as is probable, the two tracts were in former times one continuous fen, we shall doubtless find an indication of it in the similarity of their microscopic faunas.

It is well known that the present physical condition of East Norfolk is of very recent origin. Only a few centuries back, the ground on which Great Yarmouth now stands was a sandbank covered by the sea; and the extensive tract between Yarmouth and Norwich was a shallow estuary, the gradual silting-up of which has produced the present physical conformation of the district. Through this extensive flat, which lies below the level of the sea, now flow in tortuous channels the rivers Bure, Yare, and Waveney; and connected with

these rivers are numerous freshwater lakes or meres, locally called "broads," occupying, doubtless, areas which were formerly depressions of the sea-bed. These have at the present day all the external characteristics of freshwater lakes; they are mostly surrounded by wood, their edges fringed with wide and dense growths of sedge and rushes, and their shallow waters supporting luxuriant forests of aquatic weeds, *Potamogeton*, *Myriophyllum*, *Chara*, water-lilies, and the like. Yet they are to a greater or less degree subject to the influence of the tides, rising and falling to some inconsiderable extent; and though the water which thus ebbs and flows must usually be fresh, we are informed that in some broads sea-water has been known to penetrate in sufficient quantity to kill the fish. There can be no doubt that the changes which produced the present aspect of the district are still in progress, that the broads are yearly becoming shallower, and that, owing partly to the débris brought down by the rivers, partly to the choking arising from constantly decaying vegetation, they will at no distant date cease to exist. In 1827, Mr. Taylor stated their depth to range from 15 to 30 feet; at the present time, 3 to 15 feet would be a tolerably correct estimate. Mr. Stevenson tells us that "Mr. Gunn estimates the growing-up process, from subsidence of vegetable matter, aided by drainage, at a foot in twenty years, but in places this estimate must be exceeded considerably;" and he adds, "to my knowledge, where, some fifteen years back, I could pull a boat through, is now a pathway almost firm enough for a marsh-man in boots." The rise and fall of the tides along the Norfolk coast is extremely small, averaging at Yarmouth only three or four feet; yet, owing to the low level of the district, they affect the rivers for a very great distance inland. The Rev. Canon Kingsley, in an interesting paper on "the Fens," in 'Good Words' for 1867, states that, were it not for the great sea-sluice of Denver, on the Ouse, the tides would be felt to within ten miles of Cambridge. There can be no difficulty, then, in understanding how a fauna introduced when the whole East-Anglian district was overspread by the sea, should hold its ground for a lengthened period, while its habitat was year by year becoming less subject to marine influences, and that the more hardy or more plastic species should remain even after fresh water entirely usurped the place of salt, while at the same time a new fauna derived from the landward side was also gradually establishing itself, as the conditions of existence became more favourable. It is, indeed, impossible to account in any other way for the existence in the more remote broads of Norfolk, in the river Cam at Ely, and in the dykes about Whittlesea, of species purely marine (or, at least, decidedly estuarine) in

character. Their introduction along the river-channels at the present time can scarcely be thought possible; moreover there are two facts which strongly oppose such an idea. In the first place, we find in the dykes about Whittlesea several Foraminifera and Ostracoda, of marine character, which do not occur in our gatherings from the closely adjacent river Nene*, and which would therefore appear to be the relics of a previous fauna; secondly, some of the species found commonly in the most inland waters of the East-Anglian district are unknown anywhere else, and certainly cannot have been introduced from the sea. Judging from analogy, we may, indeed, say with tolerable certainty that some of them are unfitted for a marine habitat, and, at any rate, are not now to be found there.

The Ostracoda specially characteristic of the East-Anglian district, and here, (except *Cythere fuscata*) first described, are

Goniocypris mitra, *nov. gen. & sp.*	Polycheles Stevensoni, *nov. gen. & sp.*
Metacypris cordata, *nov. gen. & sp.*	Cythere fuscata, *Brady.*

More or less frequent also throughout the district, but of doubtful significance, because probably spreading beyond its limits, and being also less pronounced in external character, are

Cypris fretensis, *nov. sp.*	Limnicythere Sancti-Patricii, *B. & R.*
Cypridopsis Newtoni, *nov. sp.*	Cytheridea torosa (*Jones*) (torose form).
Candona Kingsleii, *nov. sp.*	
Candona hyalina, *nov. sp.*	

A highly interesting circumstance connected with some of the most remarkable of the new East-Anglian species, is their occurrence likewise in dredgings (for which we are indebted to Mr. E. C. Davison) taken in the Dutch rivers Meuse and Scheldt. These species are *Metacypris cordata*, *Cypris fretensis*, *Cythere fuscata*, and *Polycheles Stevensoni*. It is not likely that they lived, except perhaps *Cythere fuscata*, in the places where they were taken, near the mouths of the two rivers: we must therefore suppose that they have been washed down from inland localities, probably dykes or canals, where they may probably be as abundant as in similar situations in our Fen-district. Empty shells of the same species occur also in the same way at the mouths of the East-Anglian rivers. Other points of resemblance between the faunas of Northern Europe and Eastern England are well known, and have been noticed by the Rev. C. Kingsley, in the paper already referred to; and it is interesting and important to find a further confirmation of this relationship in the microscopic inhabitants of

* Our dredgings in the river Nene were made at several points over a course of about six miles between Peterborough and Whittlesea, and must have included every thing most characteristic of the place. It is remarkable that, though Foraminifera are very abundant in the Whittlesea dykes, scarcely any occurred in the river Nene.

the two districts. But the theory of the efflux in bygone times of many of the rivers of northern Europe, including East Anglia, into one common estuary, though, no doubt, correct, is scarcely sufficient to explain the identity of the two microscopic faunas to which we now invite attention; for most of these peculiar species appear not to inhabit estuaries or even brackish water, but solely fresh water, which in many cases may be affected by the tides, but not sufficiently so to render it to any perceptible extent brackish. It is not likely, therefore, that these species had their origin in any estuarine locality, though doubtless such a means of communication may easily have helped to spread them from one district to another. Still it seems to us most probable that the real habitat of these species was at that early time, as it is now, almost entirely beyond the reach of marine influences, consisting perhaps of an extensive series of lagoons or low-lying fens surrounding the margins of the estuary, of which the present fen-districts of England and Holland are but the remnants.

M. Félix Plateau has recently published a memoir on the freshwater Crustacea of Belgium, but does not mention any species identical with those new ones noticed by us in the East-Anglian district. It is probable, however, that his gatherings have been made entirely by the ordinary hand-net, in which case it is scarcely likely that any of our characteristic species would be obtained. In our own fen-gatherings, the *dredged material only* yielded the species to which we refer; though surface-gatherings were diligently made in most places visited by us, they yielded little or nothing of special interest. The swimming Entomostraca taken in this way were all of purely freshwater character, and such as might have been found in any British waters of like extent. Our memoranda of these captures include the following species:—

Daphnia pulex (*Linn.*).
—— vetula (*Müller*).
—— mucronata (*Müller*).
—— rotundata (*Strauss*).
Sida crystallina (*Müller*).
Polyphemus pediculus (*Linn.*).
Bosmina longirostris (*Müller*).
Lynceus sphæricus, *Müller*.
—— trigonellus, *Müller*.
—— quadrangularis, *Müller*.
—— harpæ (*Baird*).
—— costatus (*G. O. Sars*).
—— nanus (*Baird*).
—— testudinarius, *Fischer*.
—— truncatus (*Müller*).
—— globosus (*Baird*).
Eurycercus lamellatus (*Müller*).
Cypris reptans (*Baird*).
—— ovum (*Jurine*).
—— lævis (*Müller*).
—— striolata, *Brady*.
—— fusca, *Baird*.
Cypridopsis vidua (*Müller*).
—— aculeata (*Lilljeborg*).
Candona lactea, *Baird*.
—— albicans, *Brady*.
Limnicythere inopinata (*Baird*).
—— monstrifica (*Norman*).
Cyclops (*species variæ*).
Canthocamptus staphylinus (*Jurine*).
Diaptomus Castor (*Jurine*).
—— Westwoodii, *Lubbock*.
Argulus foliaceus (*Linn.*).

Amongst our dredged material from the Norfolk Broads occurred a few fragments of Amphipodous Crustacea to which we cannot with any certainty attach names, and a few entire specimens of *Gammarus pulex*: a few fragments of *Echinus*-spines were also noticed, the origin of which it is difficult to decide. It seems unlikely that fragments of such considerable size and weight could be brought up from the sea by tides for a distance of many miles; and, on the other hand, with the beds of the broads constantly accumulating layer by layer of new material, it is impossible to suppose that a light hand-dredge, such as that used by us, can have penetrated to any fossiliferous strata. Perhaps a more likely supposition is that the objects in question may have been washed *downwards* out of some exposed posttertiary deposits. Fragments of a similar character occurred also in the river Nene, near Peterborough, and possibly may there have been derived from similar sources or from the Gault. In dredgings from the river Cam, at Ely, occurred a large number of valves of Ostracoda totally different from any thing known to us amongst recent species, and, from their appearance, probably fossil. At the same time, one or two of the most remarkable of these had such a wonderfully recent and unfossilized appearance, and were in such perfect condition, as to throw a shade of doubt over the whole, especially when with them were found some really marine species, about whose recent character there can be no doubt. Further remarks respecting these will be found under our description of *Cytheridea inæqualis*.

We must here express our hearty thanks for the valuable assistance which we have received, in prosecuting our researches in the East-Anglian district, from the Rev. John Gunn, Mr. H. Stevenson of Norwich, the Rev. Canon Kingsley, and Professor Alfred Newton of Cambridge; also for information kindly given us respecting the physical peculiarities of the district by Mr. Spencer Smyth of Gorleston and Mr. Arthur Saunders of King's Lynn. To Mr. E. C. Davison of Sunderland our thanks are also especially due for help afforded in many ways, as well as for several interesting gatherings of Ostracoda, which led to the researches noted in the present paper.

The following tables show the distribution and comparative frequency of the various Ostracoda in each locality, their relative abundance being indicated by the number of asterisks affixed. We prefix a catalogue of the various localities, describing briefly their physical characteristics, and noticing such other circumstances as seemed to be of interest in connexion with the fauna.

Group I.

A. *Clyde Estuary.*—At Langbank the tide leaves bare a long

muddy flat along the river, nearly a quarter of a mile broad, and when the tide is out and the river swollen to any extent, this is covered entirely with fresh water. Our gatherings at this place were taken from low-water to near high-water mark. Other gatherings were taken from Port Glasgow up along the river for fully a mile, in four to eight feet water beyond low tide. In some places the bottom is soft black mud, in others muddy gravelly sand, much covered by mussels (*Mytilus edulis*). The estuary here is a few miles broad, and the tide rises from eight to ten feet, the fresh water being much less felt than at Langbank, which is about four miles further up, where the water narrows greatly as it reaches Dumbarton Castle. It is somewhat remarkable, considering the extent of the gatherings, the diversity of bottom, and very promising appearance in every way of the locality, together with the profusion of *Corophium*, Isopoda, and other forms of animal life, that the Ostracoda and Foraminifera met with were exceptionally few, both in number of species and individuals, and these mostly of brackish or freshwater type. We are inclined to suppose that the great amount of chemical refuse poured into the river Clyde from around Glasgow and Paisley may account for the scarcity of these animals. In the river Wear, where somewhat similar conditions exist, we have found the fauna affected in exactly the same manner. That some artificial cause is at work seems almost certain, as we have not found so poor a microscopic fauna in any river unconnected with manufacturing operations.

B. *Montrose Basin, Forfarshire*, is an area of considerable extent, communicating with the sea by a narrow channel. The whole area, with the exception of the tortuous channels of the river South Esk, is left dry at low water, exposing a muddy flat; at high water it is covered to a depth of six feet by the sea.

C. *Budle Bay, Northumberland.*—The description of Montrose Basin applies also pretty accurately to this locality, except that Budle Bay is exposed across the whole of its wide mouth to the action of the sea. It is thus, owing to want of shelter, a less favourable place for the habitation of organisms requiring an undisturbed muddy bottom and quiet water. Our gathering was taken from almost the only sheltered spot in the bay, on a bottom of hard muddy sand just beyond low-water mark, and behind a small quay or breakwater belonging to the coast-guard service. Samples of sand collected in other more exposed spots showed no trace of animal life. Two small streams, the Warn burn and the Buckton burn, empty themselves into the bay; but their channels on the tidal flat were not examined, owing to difficulty of access.

D. *Warn Burn.*—This gathering was from a sheltered pool in the bed of the burn, not more than about a hundred yards above its outlet into Budle Bay. The bottom consisted of rather coarse sand and stones. The stream, coming down through a somewhat hilly country, and subject, no doubt, to strong currents and violent floods, exhibits a very scanty fauna when compared with others in the same district, but of a more sluggish character, especially the river Blyth, about thirty miles further south.

E. *River Aln above Alnmouth.*—The bed of the river above the mouth is everywhere muddy, more or less hard according to exposure and rapidity of current. Our examples were taken from beyond low-water mark, just below the "Duchess's Bridge;" the bottom a rather tenacious mud.

F. *River Coquet at Warkworth Hermitage.*—At this spot the river, though subject to a rise and fall of many feet, has, owing to its precipitous banks, always a considerable depth of water at low tides. The bottom consists of a hard muddy or loamy sand, and must often be much scoured by the floods to which the river is subject.

G. *River Wansbeck.*—Gathering taken from near low-water mark, in a somewhat strong current, about half a mile from the mouth of the river; bottom of fucus-covered stones. Probably a more sheltered and muddier spot, which might have been found higher up the river, would have yielded a larger variety of species.

H. *River Blyth*, at the junction of the Sleek burn, about two miles from the sea.—Gatherings taken from below low-water mark, partly from the bed of the Blyth, but chiefly from a small pool above some stepping-stones on the Sleek burn; bottom of soft black mud. This river, draining a low country, is slow and deep throughout the greater part of its course, and for a distance of several miles from its mouth exposes at low water a large surface of muddy banks to the air.

I. *River Ouse, Yorkshire.*—From muddy sand at low-water margin of river, a short distance above Goole, forty-five miles from the sea. Though the average rise of the tide at high water is twelve feet, the water at low tide is fresh.

J. *River Humber.*—A dredging on the Ferrity Sand, three miles above Hull (and twenty-three miles from the sea), where the river is about two miles and a half wide, and the depth at low water is six feet, and at high water twenty-four feet. The Humber, receiving the drainage of a larger extent of country than any other river of England, the amount of fresh water carried by it to the German Ocean is considerable. The material dredged was a fine reddish sand mixed with vegetable remains.

K. *River Deben at Woodbridge;* L. *River Stour at Manningtree.*—These rivers are of a character very similar to the river Blyth (H), though of larger dimensions, and, owing to their course through an exceedingly flat country, affected by the tide to a much greater distance from the sea. Our gatherings were got chiefly from beyond low-water mark; those from the Deben at about eight miles from the mouth of the river, the average rise of the tide being eight feet; those from the Stour at about twelve miles from its mouth, the rise of tide ten feet.

M. *Estuary of the Thames.*—The collections from the Thames estuary, with the exception of one from the "Girdler Sand," which was procured from a portion of the bank uncovered at low water, were obtained by dredging in various parts of the estuary between a line joining Margate and the Maplin lighthouse to the eastward, and the Nore to the westward; the depths were from two to twelve fathoms; the average rise of tide at high water over this district is fourteen feet.

N. *Fowey Harbour.*—Dredged in from three to five fathoms, in the harbour, which is the outlet of the river Fowey or Lostwithiel, Cornwall. Average rise of tide at high water thirteen feet.

Group II.

O. *Dykes on the site of Whittlesea Mere;* P. *"Whittlesea Dyke," south of Whittlesea.*—These are artificial drainage-channels, containing in all weathers a few feet of water, and in winter, on the site of the old Whittlesea Mere, often overflowing their banks to a considerable extent; they contain abundant aquatic vegetation.

Q. *River Nene, between Peterborough and Whittlesea;* R. *River Cam at Ely.*—These rivers have a very sluggish current, and in appearance are more like canals than rivers, the present course of the Nene being, indeed, in great part an artificial one. In both cases our gatherings were taken from the bed of the river, in the Nene at several points over a course of about six miles, in the Cam over a very small area near the bridge; the distance from the sea is in both cases about thirty miles. Notwithstanding the apparently marine character of some of the species found in both rivers, it must be remembered that sea-water finds no access whatever to these localities, being entirely shut out by the Denver sluice. And even long before the construction of this sluice, it is probable that any tidal influence felt at these remote points would be confined to the driving back of the fresh, rather than the influx of salt water.

S–Y. *The Broads of Norfolk and Suffolk* may be considered as expansions of the various tidal rivers, though situated at

such distances from the sea as to be but slightly influenced by tidal ebb and flow. Wroxham and Barton Broads, the most distant of the group, are, in a direct line, sixteen miles from their sea-outlet; but, the river-channel being exceedingly tortuous, their real distance is very much greater. They support mostly a rank vegetation of freshwater character, being fringed with dense masses of sedge and rushes, under the shelter of which, and often far out into the lake, grow patches of water-lily, water-milfoil, and other aquatic weeds. Hickling Broad constitutes, however, an exception to this rule, its vegetation consisting to a large extent of a *Chara*, which is so abundant as to afford occupation to some of the neighbouring population in fishing it up and selling it at the rate of ninepence a ton. The broads are uniformly shallow, varying from three to fifteen feet in the channels, and (except Hickling, which is gravelly) have a bottom of peaty or decaying vegetable matter; they are probably in all cases fast filling up. Sea-water appears to find access to some of them to a small extent at very high tides, about once in six or seven years.

From particulars obligingly furnished by Mr. Spencer Smyth, we here extract the following:—"The level of the broads Higham and Hickling seldom varies three inches; and they are not affected by saline particles injurious to fish, except after extreme high tides at Yarmouth—say, eleven feet, or two following tides of nearly that height, occurring perhaps once in six or seven years: at such times some pike and bream are killed in Hickling, but, I believe, not in Horsey or Martham Broads, the former only reached by a long, tortuous, and narrow dyke from the upper part of Whittlesea, and Martham by an equally difficult although shorter channel from the river Thune. Martham Broad is fast filling up, choked by reeds, with only a sailing channel four feet in depth for small wherries to Somerton and Martham. Higham and Hickling are also growing up; but the channel has four feet and a half till near Hickling, where it falls off to three and a half." This extract, though not referring entirely to broads visited by us, applies pretty accurately to all, the more remote ones (*e. g.* Wroxham and Barton), however, being even less affected by tides. The information is especially valuable as coming from one whose official duties are connected with the survey of the navigable river-channels of the district.

z. *Lake Lothing* is a tidal expanse separated from Oulton Broad, at its western extremity, by an embankment, through which canal-boats pass by means of a lock. In this way some slight communication exists between the waters of the two basins; but the true outlet of Oulton Broad is by the river Waveney, which from this point takes a circuitous course of

about fifteen miles to Breydon Water. The western end of Lake Lothing has quite a marine appearance, its stones being coated with the usual Algæ of the upper littoral zone. Our gatherings are from the soft black mud of the channel beyond low-water mark. The sea was once known, on the occasion of an unusually high tide, to break over the top of the lock into Oulton Broad.

A a. *River Bure near Yarmouth.*—These gatherings were from the bed of the river, below low-water mark, the bottom consisting of stones and mud.

B b. *Breydon Water*, a large tidal basin which receives the waters of the rivers Bure, Yare, and Waveney, is situated to the west of Great Yarmouth. It is about four miles long by a mile broad, and a large proportion of its surface is left dry at low water. Our gatherings extended from Yarmouth to the confluence of the rivers Yare and Waveney, and were taken both in mid-stream and more or less over the sides. The bottom at some places was coarse sand, at other parts black or brownish coloured mud.

C c. *River Ouse* (*Norfolk*) *at Lynn.*—Muddy sand, from low-water margin of the river. Rise at spring-tides eighteen feet.

D d. *River Scheldt, Antwerp.*—"Material a light-coloured sand mixed with vegetable remains. It was obtained from a sandbank near the town, where the river is a quarter of a mile wide. The rise of tide at springs is fifteen feet. Distance from the sea about sixty miles."—*E. C. Davison.*

E e. *River Maas or Meuse, near Schiedam.*—"Material somewhat similar to the last mentioned. A good many years have elapsed since I obtained them, and my information is but scanty respecting the localities."—*E. C. Davison.*

Genus Cypris, Müller.

Cypris ventricosa, nov. sp. (Pl. IV. figs. 1–3.)

Carapace (of the female?), as seen from the side, subelliptical, highest in the middle; greatest height equal to nearly two-thirds of the length; anterior extremity somewhat obtusely, posterior boldly rounded: superior margin boldly arched, highest in the middle, where it is somewhat gibbous; inferior almost straight, slightly sinuated, however, in the middle, in front of which is a slight convex protuberance. Seen from above, ovate, widest in the middle, thence tapering gradually towards the anterior extremity, which is sharply acuminate; posterior extremity well rounded, greatest width equal to half the length: end view broadly oval, nearly circular. Surface of the shell smooth, sparingly

beset with minute rounded papillæ. Colour (of dried specimens) very slight, whitish. Lucid spots narrow, crescentic. Length $\frac{1}{12}$ inch. Animal unknown.

Hab. Site of Whittlesea Mere. Only one or two perfect specimens obtained.

Cypris tumefacta, nov. sp. (Pl. IV. figs. 4–6.)

Carapace (of the female?) very tumid, seen from the side, subreniform, highest in the middle; greatest height equalling rather more than half the length; extremities rounded, sloping steeply above the middle: superior margin very boldly arched, rising almost to a point in the middle, inferior gently sinuated in the middle. Seen from above, broadly ovate, suddenly and acutely mucronate in front, well rounded behind; sides subparallel, greatest width situated in the middle, and somewhat greater than the height: end view subrhomboidal, pointed above, broadly rounded below, sides excessively convex. Shell perfectly smooth, opaque white. Length $\frac{1}{25}$ inch. Animal unknown.

Hab. Warn burn and river Coquet, Northumberland.

If viewed only from the side, this species might not unreasonably be suspected to belong to *C. virens* or perhaps *C. incongruens*; but when seen in any othe rdirection, this similarity entirely disappears: no species possesses a more characteristic or well-marked contour when looked upon from above. In the Warn burn about half a dozen specimens were found, in the river Coquet only one.

Cypris fretensis, nov. sp. (Pl. IV. figs. 7–9.)

Carapace of the female, as seen from the side, broadly reniform, highest in the middle; height equal to more than half the length; anterior extremity broad and well rounded, posterior narrower, rounded, but emarginate above the middle, owing to the overlapping of the left valve, which is produced below the middle: superior margin boldly and evenly arched, inferior gently sinuated in the middle. Seen from above, compressed, ovate, widest behind the middle; posterior extremity rounded, anterior obtusely pointed; width equal to about two-thirds of the height: end view ovate, pointed above, broadly rounded below. Valves smooth, minutely and closely punctate; right valve crenulated in front and on the posterior portion of the ventral margin; the left valve has a row of small tubercles parallel to and a little within the anterior border: the margins of the valves are considerably incurved along the posterior

portion of the dorsal aspect, forming a distinct longitudinal sulcus when viewed from above. Length $\frac{1}{20}$ inch.

Hab. Rivers Deben and Scheldt, Breydon Water and Lake Lothing, Somerton Broad and dykes on the site of Whittlesea Mere.

The specimens from the last locality are doubtfully referred to the present species. *C. fretensis* is more nearly allied to *C. salina*, Brady, than to any other British species, but differs from it in the less compressed and more distinctly ovate form of the carapace when seen from above, in the peculiar emargination of the posterior margin, in the absence of the peculiar form of contact margin which distinguishes the valves of the latter species, as well as in other characters of form. We have not observed any colour-markings in this species; but those of *C. salina* are also sometimes observed to be wanting.

Genus Cypridopsis, Brady.

Cypridopsis (?) *Newtoni*, nov. sp. (Pl. VII. figs. 14–16.)

Carapace, as seen from the side, reniform; greatest height in the middle, and equal to a little more than half the length; extremities rounded, the anterior being the broader of the two: superior margin boldly and evenly arched, inferior sinuated in the middle. Seen from above, compressed, ovate, acuminate in front, rounded behind; greatest width [illegible]ituated near the middle, much less than the height. Sur[illegible]e of the shell punctate, and covered with numerous ad[illegible]ed hairs; colour dull green. Length $\frac{1}{30}$ inch.

[illegible]ers Nene and Cam, and dykes on the site of Whittlesea [illegible]

[illegible]mples of this species are not numerous, and we have not [illegible]ccessful in finding perfect specimens of the contained [illegible]l. The postabdominal rami are rudimentary, as in *Cy*[illegible]*is*; but the lower antennæ seem to be destitute of the set[illegible]sh, which in that genus is usually very long. The spe[illegible]uld therefore appear to be an aberrant one; but, without a [illegible]rough acquaintance with its internal structure, we think [illegible] best for the present to place it in the genus to which it is here assigned. It approaches closely in external appearance to *Cypridopsis villosa* and *Potamocypris fulva*; it is, however, larger than either, is more tumid, less strongly arcuate, and coarser in texture than the former; while the almost equal and well-rounded valves, coarsely hispid surface, and ovate form when seen from above sufficiently distinguish it from the latter: it agrees very much with Fischer's figures of *Cypris prasina*, but is more elongated and more densely hairy.

We have great pleasure in inscribing this species to Prof. Alfred Newton, of Cambridge, whose assistance we have acknowledged in a previous page.

Cypridopsis obesa, B. & R.,

which was described by us from specimens taken in the Mullingar Canal at Dublin, we now believe to be probably a variety of *C. vidua*; but as there is still some doubt on the subject, we hesitate to cancel the name *obesa*. Our Dublin specimens seemed to have little in commom with *C. vidua*, except their shape; they were of a uniform brown colour, without any transverse bands; in fact we never even suspected any relationship to *C. vidua*. Since that time, however, we have found specimens which we refer to *C. obesa*, in many places always more or less subject to tidal influence, and have observed that they vary much in colouring, being in brackish water usually of a dirty grey tint, and approaching brown in fresh water; moreover some of those taken at Whittlesea, though brownish in the ground tint, had distinct dark bands, after the manner of *C. vidua*. In some localities both species occurred together; but it is remarkable that *C. vidua*, when it occurred in *dredged* material, was never otherwise than scarce, whereas *C. obesa* was often exceedingly abundant; on the contrary, gatherings made with the hand-net amongst weeds or in clear water, though often containing *C. vidua* in plenty, never showed a single specimen of *C. obesa*; so that it appears certain that the brilliantly banded *vidua* and the dingy *obesa*, whether we regard them as distinct species or merely as varieties, live often in the same situations, the one on the bottom mud, the other amongst the supernatant weeds.

Genus Goniocypris, nov. gen.

Valves compressed, subequal, thin, and fragile. Seen from the side, triangular, the inferior margin terminating at each extremity in an acutely produced angle, the superior margin rising to an acute central point; hinge simple. Animal unknown.

Goniocypris mitra, nov. sp. (Pl. VII. figs. 10–13.)

Carapace, as seen from the side, triangular; right valve rather larger than the left; height and length nearly equal; anterior and posterior margins obliquely arched (the anterior the more convex) and meeting in an acute point nearly over the centre of the shell: inferior margin straight, produced downwards at each extremity into an angular point. Seen from above, compressed, ovate, widest in the middle; extremities obtusely and nearly equally pointed; width equal

to half the length: seen from the front, ovate, widest below the middle, pointed above, broadly rounded below. Shell thin, semitransparent, sparingly and minutely punctate, or often perfectly smooth, somewhat granular in appearance. Colour yellowish or reddish brown. Length $\frac{1}{80}$ inch.

Hab. Dykes on the site of Whittlesea Mere, "Whittlesea Dyke;" rivers Nene at Peterborough, Cam at Ely, and Ouse at Lynn; Wroxham, Barton, Somerton, and Ormesby Broads.

Though generally distributed throughout the East-Anglian district, this remarkable species appears to be rather rare as to number of individuals; nor have we succeeded in finding a trace of animal structure in any specimen that we have examined. The minuteness of the shell may perhaps partly account for its apparent rarity; and as we have not met with it except in dredged material, we presume that it is a creeping rather than a swimming species, and probably inhabits exclusively the muddy bottoms of the broads and rivers.

Genus Argillœcia, G. O. Sars.

Argillœcia (?) *aurea*, nov. sp. (Pl. VIII. figs. 4, 5.)

Carapace, as seen from the side, compressed, subovate, somewhat depressed in front, nearly of the same height throughout; height much less than one-half of the length; extremities rounded, the anterior narrowed and oblique: superior margin straight or very gently convex in the middle, curving gently downwards at each extremity; inferior very slightly convex along its whole length. Seen from above, ovate, acuminate in front, rounded behind; greatest width situated in the middle, and about equal to the height. Surface of the shell quite smooth; colour golden yellow. Length $\frac{1}{50}$ inch.

Hab. River Ouse at Lynn.

But one specimen of this species was noticed; and we place it provisionally only in the genus *Argillœcia*.

Genus Candona, Baird.

Candona candida (Müller), var. *tumida*. (Pl. IX. figs. 13–15.)

Throughout the East-Anglian district occurs a form of this species differing from the typical *C. candida* chiefly in its excessive shortness and tumidity. In the female the greatest height is equal to nearly two-thirds of the length, and the width to more than half of the length. Seen from above, the extremities are very abruptly tapered, giving an almost elliptical contour. The male is much more compressed, but more tumid than in the ordinary form of the species. The lucid spots are

arranged in a rosette, five in number, each being broadly cuneate in shape, their apices directed towards the centre of the group.

It is remarkable that *Candona compressa*, Koch, which occurs also very abundantly throughout the district, likewise puts on an excessively tumid form, differing almost as much from the typical form as does the variety of *C. candida* just described (see Pl. VII. figs. 8, 9).

Hab. We have found the tumid variety of *C. candida* abundantly in the dykes in the neighbourhood of Whittlesea, also in the rivers Nene, Cam, and Scheldt, in Barton Broad, and in the Warn burn, Northumberland. The normal form occurs also constantly throughout Norfolk and Suffolk, and, so far as we know, throughout the kingdom. *Candona compressa* we found in all our East-Anglian gatherings, except those from Hickling Broad and the rivers Bure and Ouse.

The two forms of *C. candida* run into each other so much that it is sometimes difficult to say whether an example should be referred to the species or its variety. The rosulate disposition of the lucid spots, however, and the peculiar reticulation of the posterior portion of the shell (figured in the 'Monograph of Recent British Ostracoda'), are usually visible only in the tumid variety. We are not aware that this form ever occurs in localities entirely uninfluenced by the tides.

Candona Kingsleii, nov. sp. (Pl. IX. figs. 9–12.)

Carapace of the female, as seen from the side, subreniform; greatest height near the middle, and equal to half the length; extremities rounded: superior margin boldly arched, inferior rather deeply sinuated in the middle. Seen from above, ovate, width somewhat less than the height, greatest in the middle; pointed in front, sharply rounded behind. Shell of the male, as seen from the side, more deeply sinuated below; the dorsal margin obscurely sinuated in front of the middle, and more arched than in the female: seen from above, much more compressed: shell thin and fragile, colourless, showing the limbs of the animal distinctly through it. Length of the female $\frac{1}{25}$ inch.

Hab. River Nene; Barton, Horsey, and Hickling Broads; Breydon Water.

The specimens from the last-mentioned locality somewhat differ from the rest, but probably belong to the same species.

It is with much pleasure that we dedicate this elegant species to the Rev. Canon Kingsley, in acknowledgment not only of the great services which he has rendered and is still rendering in popularizing the study of natural history, but also

of his kind assistance in the prosecution of our researches in the Fen-district.

Candona diaphana, nov. sp. (Pl. V. figs. 1–3.)

Carapace of the *male* (?), as seen from the side, elongated, subreniform; greatest height situated behind the middle, and equal to less than half the length; obtusely and evenly rounded in front, obliquely behind; superior margin highest at the posterior third, thence sloping almost in a right line and with a very gentle declivity forwards, very steeply and with a slightly concave curve backwards; inferior margin gently sinuated. Seen from above, compressed, tapering equally and rather suddenly to the extremities, which are pointed; sides subparallel; width scarcely equalling one-third of the length. The hinge-margin of the left valve is suddenly produced towards each extremity into a very conspicuously overlapping curve, the posterior being much larger than the anterior. Shell-structure as in the preceding species. Length $\frac{1}{26}$ inch.

Hab. Ormesby Broad, and the river Nene at Peterborough. One specimen only from each locality. From the compressed outline and very pronounced characters of the shell, we suppose this to be probably the male. The limbs are not sufficiently preserved to indicate the sexual character through the shell.

Candona hyalina, nov. sp. (Pl. IX. figs. 5–8, and Pl. V. figs. 4–11.)

Carapace of the female, as seen from the side, reniform, highest near the middle; height scarcely equalling half the length; extremities rounded, the posterior obtusely; superior margin well arched, but behind the posterior third distinctly hollowed out and steeply sloping; inferior distinctly sinuated in the middle. Seen from above, ovate, widest in the middle, with acutely and equally pointed extremities; width equal to one-third of the length. Hinge-margin as in *C. diaphana*; the curved projections, however, scarcely so prominent, more so in the male than the female. Shell of the male more compressed; seen from the side, the inferior margin more deeply sinuated; superior margin excessively elevated and gibbous in the middle, behind which it suddenly dips and slopes steeply backwards with a marked concave curve. Shell-structure as in the two preceding species. Superior antennæ sparingly setose, last two joints of nearly equal length, about twice as long as broad, the rest shorter and thicker; inferior antennæ destitute of any proper setose brush, the place of which is occupied in the

male by three short setæ with much thickened bases. Mandibles narrow and weak, but armed with long teeth (fig. 6); branchial appendage formed of one long ciliated seta, and one much shorter and lancet-shaped; second pair of jaws in the female bearing as usual a simple or indistinctly jointed conical palp (fig. 7), in the male a very large abruptly curved hook-shaped appendage; no branchial plate. Mucus-glands (testes?) of the male very small and abnormal in structure, consisting apparently of a thickened cylinder, which is beset with marginal and transverse rows of obscurely radiated tubular or filamentous structure (fig. 10). Copulative organs of exceedingly complex structure, composed chiefly of a large oblong lamina, from which springs a strong hook-shaped process; attached to these are also several other tortuous and spinous or hook-like appendages (fig. 11). Postabdominal rami (fig. 9) well developed; two long and nearly equal terminal claws, and one minute seta; also from the border of the ramus, a little below the middle, one long slender seta. Length of female $\frac{1}{25}$ inch, of male $\frac{1}{18}$ inch.

Hab. Site of Whittlesea Mere; Wroxham, Barton, and Ormesby Broads.

This and the preceding species, *C. diaphana*, have in common two very remarkable characters—the abruptly curved hinge-margin of the left valve, and the gibbous dorsal margin with its hollowed-out posterior termination. Some species described and figured by Fischer ("Ueber das Genus *Cypris*") very closely approach them; but none, so far as we can judge, are identically the same: those most nearly allied are *Cypris rivularis*, *pellucida*, *fabæformis*, and *compressa*. The small number of our specimens and the imperfect preservation of their animal structure have prevented our ascertaining as accurately as might be wished many points of their minute anatomy; and though we think it likely that this group might with propriety form the basis of a new genus, for the present we refer them to *Candona*, to which they exhibit the closest resemblance.

Genus Metacypris, nov. gen.

Shell moderately strong and thick. Seen from the side, the outline is subrhomboidal, rounded in front, and obscurely angular behind; the posterior portion of the hinge-margins produced angularly. Seen from above, heart-shaped, excessively tumid, widest behind the middle: ventral surface deeply impressed along the central and posterior portions of the median line. Hingement formed on the *right* valve by

a laminated angular projection anteriorly (fig. 7 *c*), posteriorly by a strong rectangularly produced flange (fig. 7 *d*, fig. 5 *d*, and fig. 9 *d*), from which projects a single sharply cut tooth, the flange itself being continued round the posterior margin of the valve (fig. 9 *e*); on the *left* valve by a deep sulcus behind, and a shallower one in front (fig. 6 *f*, *g*). Except in front and at the supero-posteal angle, the margins of the valves are incurved considerably, so that the actual contact-margins embrace a much smaller area than that of the entire shell; the right valve is larger than the left. Animal unknown.

Metacypris cordata, nov. sp. (Pl. VI. figs. 1–9.)

Carapace excessively tumid and depressed: seen from the side, subovate or subrhomboidal, highest in the middle; height equal to more than half the length: anterior extremity well rounded, posterior obscurely angular: superior margin gently arched, produced at its posterior extremity into an angular process, corresponding in position to the posterior hinge-joint; inferior margin distinctly convex, curving upwards behind, in front rather deeply and abruptly sinuated at its junction with the anterior margin. Seen from above, the outline is heart-shaped, pointed in front; posterior extremity broadly rounded and indented at the junction of the two valves; greatest width situated behind the middle, much greater than the height, and equal to about five-sixths of the length; the lateral margins are boldly curved and somewhat sinuous in the anterior part of their course; end view subreniform, depressed; sides excessively convex; superior margin arched and slightly indented in the middle, inferior deeply sinuated in the middle, where, however, it is encroached on by the downwardly produced anterior margin. Surface of the valves closely set with small rounded impressions, which are arranged in longitudinal rows, running on the ventral surface into interrupted furrows; ventral surface deeply and broadly sulcate along the greater part of the median line. Colour brownish yellow. Length $\frac{1}{50}$ inch.

Hab. Rivers Nene, Cam, and Scheldt, Wroxham and Barton Broads, and Breydon Water. Scarce in all these localities.

We much regret that we have been unable to find a trace of the animal structure of this remarkable species, all our specimens being merely empty shells, the abnormal external characters of which leave no doubt as to the propriety of establishing for it a new genus; but it is not so clear whether it ought to be placed amongst the Cypridæ or the Cytheridæ.

Genus CYTHERE, Müller.

Cythere fidicula, nov. sp.

Carapace, as seen from the side, trapezoidal; height equal to not much more than one-third of the length; extremities narrowly rounded below, above the middle sloping steeply upwards to the short and straight superior margin, which they join at an obtuse angle; inferior margin almost straight, but slightly protruded in front of the middle by a rounded tubercular eminence. Seen from above, elongated, subhexagonal, with parallel sides and obtuse or subtruncate extremities; the two anterior angles well marked, the posterior rounded off; width equal to the height; seen from below, the ventral surface exhibits at its anterior angles two prominent rounded eminences, behind which it becomes slightly constricted, again swelling out into a convex margin behind the middle; the outline on this aspect is thus remarkably fiddle-shaped. End view triangular, apex rounded off, basal angles prominent and acute, sides convex, base concave. Shell marked with irregular and sinuous longitudinal rugæ, which on the concave ventral surface are especially conspicuous. Length $\frac{1}{54}$ inch.

Hab. Estuaries of the rivers Thames, Scheldt, and Meuse; very rare in all these localities. One specimen has also occurred in a dredging from the north of Scotland.

Genus CYTHERIDEA, Bosquet.

Cytheridea torosa (Jones). (Pl. VIII. figs. 6, 7.)

A peculiar form of this species, which occurs commonly throughout Norfolk and Suffolk, but has not yet been found in the recent state elsewhere, requires a few words of notice. It agrees closely with the typical fossil specimens described by Professor Rupert Jones, and differs from the common recent form only in the presence, on the sides of the valves, of several large rounded eminences or tubercles, which are variable as to number and position; but the appearance of a well-marked example may be understood from our fignres. The single infero-posteal spine is perhaps less frequently present than in the smooth form. Both the smooth and torose forms occur abundantly in many localities, and sometimes in company, and both exhibit their peculiar characters in very early stages of growth; but there are many grades between perfectly smooth specimens and the strongly marked valves represented in our plate*. We find the *smooth* form (*C. littoralis*, Brady),

* I take this opportunity of withdrawing an opinion recently expressed by me as to the synonymy of the present species, in a paper on the

which we propose to call var. *teres*, commonly in the river-outlets and salt-marshes of Northumberland and Durham, in the rivers Ouse (Yorkshire and Norfolk), Deben, Stour, Cam, Bure, Thames, Scheldt, and Meuse, in all theb roads visited by us except Wroxham, in Lake Lothing and Breydon Water, and in the dykes about Whittlesea. The typical *torose* form we have not found at all north of Norfolk; but it occurs in all the broads known to us, except Barton, in Lake Lothing and Breydon Water, and in the river Bure: it thus appears to be peculiar to the East-Anglian district. It is worthy of note that this species has not occurred to us at all in Scotland, except in one gathering from the Clyde near Dumbarton Castle (var. *teres*), though that it is not a strictly southern species is shown by its occurrence abundantly, according to G. O. Sars, in Christianiafiord. It is remarkable also that, though occurring abundantly in the dykes on the site of Whittlesea Mere, it was not found in the closely adjacent river Nene.

Cytheridea inæqualis, nov. sp. (Pl. IX. figs. 1–4.)

Carapace, as seen from the side, subtriangular; greatest height situated in the middle, and equal to two-thirds of the length; anterior extremity broadly rounded, posterior broad, scarcely rounded: superior margin excessively arched, highest in the middle, sloping with a gentle curve towards the front, more steeply behind, where it is obscurely angulated. Seen from above, lozenge-shaped; greatest width in the middle, equal to half the length; extremities obtusely pointed; end view subtriangular, twisted. Right valve very much smaller than the left, its superior and posterior margins obtusely angulated in the middle; anterior margin fringed with a row of eight long and sharp spines directed forwards and downwards; posterior margin having at the lower angle one long and four smaller rudimentary spines: left valve devoid of spinous armature, and overlapping the right throughout its entire circumference. Surface of the shell polished, obscurely

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"Crustacean Fauna of the Salt-Marshes of Northumberland and Durham" (see Natural-History Transactions of Northumberland and Durham, vol. iii. p. 125). Not having at that time seen any recent *torose* carapaces, I was led to refer the imperfect specimens in Prof. Rupert Jones's collection to a closely allied species, *C. lacustris* (G. O. Sars), to which it is indeed probable that one or two of Prof. Jones's examples may be referred; but his figures given in the Monograph of the Tertiary Entomostraca clearly represent the form now under consideration. I therefore withdraw the specific name *littoralis*, and revert to the nomenclature adopted in my 'Monograph of the Recent British Ostracoda,' considering the form there called *Cytheridea torosa*, and afterwards *littoralis*, as a variety (*teres*) of that originally described by Prof. Rupert Jones.—G. S. B.

waved, impressed with distant rounded punctures: lips of the valves much thickened and rounded, those of the ventral surface somewhat depressed. Animal unknown. Length $\frac{1}{32}$ inch.

Hab. Dredged in the river Cam at Ely. One specimen only taken.

We have already mentioned that several Ostracoda and some fragments of other animals (*Echinus*-spines and shells of *Balanus*) were met with in our dredgings from the river Cam. The fragments of *Echinus* and *Balanus* must be regarded as fossil, and may have been derived either from some posttertiary deposit or from the Gault. It becomes difficult under these circumstances, where the animal itself is absent, to decide which of the Ostracoda are recent and which fossil specimens; but that from which our present description is taken is altogether so unlike a fossilized shell, being semitransparent, highly polished, and in almost perfect condition as regards the preservation of its spines and surface-markings, that we can scarcely doubt its recentness. If it be really so, it constitutes a most interesting addition to the fauna, not only by reason of its peculiar configuration, but of its occurrence in fresh water. The only known recent species at all nearly resembling it is *C. Sorbyana*, Jones (*dentata*, Sars), which exhibits the same differences in the form of the right and left valves, but differs greatly in general form. Some of the fossil specimens obtained in the river Cam belong to strongly spined and probably deep-sea species. But associated with them occurred examples of several species usually found at the present day living in estuaries or in littoral marine situations: these we regard as being of recent origin; they are as follows:—*Pontocypris trigonella* (?), *Cythere castanea*, *C. villosa*, *C. laticarina* (?), *Cytheridea torosa*, var. *teres*, *Loxoconcha elliptica*, *L. tamarindus*.

Genus Loxoconcha, G. O. Sars.

Loxoconcha pusilla, nov. sp. (Pl. VIII. figs. 1–3.)

Carapace, as seen from the side, subrhomboidal, nearly equal in height throughout; height equal to half the length; extremities obliquely rounded; superior and inferior margins straight. Seen from above, the outline is regularly ovate, widest in the middle, extremities nearly equally acuminate, width considerably less than the height. Shell delicate and fragile, faintly rugose, and marked also with a few scattered hairs and papillæ. Length $\frac{1}{60}$ inch.

Hab. Montrose Basin, Firth of Forth; rivers Wansbeck, Blyth, Deben, Ouse (Norfolk), and Scheldt. Scarce in all these places.

Its small size and peculiar shell-structure distinguish it readily from *L. elliptica* and *tamarindus*, with which alone it could be confounded.

Loxoconcha fragilis, G. O. Sars. (Pl. X. fig. 3.)

Loxoconcha fragilis, G. O. Sars, Oversigt af Norges marine Ostracoder, p. 65.

Shell of the female, seen from the side, subrhomboidal; greatest height situated in front of the middle, greater than half the length; anterior extremity rounded, posterior produced below into a short obliquely truncated process; superior margin moderately arched over the eyes, thence sloping backwards; inferior sinuated in the middle, convex behind. Seen from above, compressed; greatest width situated in front of the middle, and much less than the height; posterior extremity slender and produced. Shell of the male narrower; length equal to twice the height; superior margin nearly straight and horizontal; posterior extremity obtusely rounded below. Valves excessively thin and fragile, almost transparent, ornamented sparingly with very small tubercles and but slightly hairy. Antennæ very slender; second joint of the superior short, much shorter than the united lengths of the two following, and shortly pilose on the anterior margin, last three joints much elongated and nearly equal; third joint of inferior antennæ very narrow, its anterior margin smooth, without any setæ. Feet very slender, second joint of the last pair about equal to the conjoined length of the two following. Copulative organs of the male obtusely produced in front. Eyes confluent. Length of female $\frac{1}{60}$ inch.

Hab. Montrose Basin and Budle Bay.

The few specimens of this species which have occurred to us consist only of separated valves, from one of which our figure was drawn*. The description given above is taken from G. O. Sars.

Genus Cytherura, G. O. Sars.

Cytherura propinqua, nov. sp. (Pl. X. figs. 1, 2.)

Carapace, as seen from the side, subrhomboidal, approaching *C. similis* in shape; greatest height situated in the middle, and equal to about half the length; anterior extremity well and evenly rounded, posterior produced in the middle into an obtuse subtruncate process: superior margin evenly arched, inferior straight or very slightly sinuated. Seen from above, compressed ovate, slender and acuminate in front, broadly mucronate behind; greatest width behind

* Since this was written we have found perfect examples in a Scottish dredging.

the middle, and very much less than the height. Animal unknown. Length $\frac{1}{60}$ inch.

Hab. Thames estuary.

Genus POLYCHELES, nov. gen.

Shell fragile, structureless. Carapace oblong, higher behind than in front; lucid spots ten to twelve, linear-oblong or wedge-shaped, arranged in a subradiate manner in front of the centre of the valve. Seen from the side, compressed, oblong, subovate: seen from above, ovate, acuminate in front, obtusely rounded behind. Valves unequal, the right much larger than the left. Limbs of the animal very short and stout, strongly armed with short curved claws and bristles; superior antennæ six-, inferior four-jointed, and bearing strong terminal claws; mandible simple, weak (having no palp?), armed at the extremity with four or five small slender teeth; first maxilla composed of a broad, squarish basal portion, from the distal border of which spring eight long and strong curved setæ, and from its anterior extremity a long biarticulate digit, which terminates in four curved claws, two of which are long, and two short; second maxilla consisting of four digits, the anterior larger and stouter than the rest, biarticulate, and terminating in four slender claws, the other three single-jointed, small and slender, each terminating in two long setæ; at the base a large branchial plate surrounded by about thirty plumose processes. First pair of legs small, almost rudimentary, four-jointed, second and third five-jointed, the third much the longest, its last joint armed with two strong curved claws and one shorter seta; the longer of the two claws twice the length of the shorter. Abdomen ending in a short conical process. Copulative organs of the male of complex structure, the basal portion (on each side) consisting of a subrhomboidal acuminate lamina, the apical portion of an irregularly shaped plate produced laterally into an aliform process, and on the distal margin into a short, strong hook. Female probably viviparous.

Polycheles Stevensoni, nov. sp. (Pl. VII. figs. 1–7, and Pl. X. figs. 4–14.)

Carapace of the female, as seen from the side, oblong, depressed in front, height equal to more than one-third of the length; extremities obliquely rounded, anterior narrowed, posterior broad and obtuse: superior margin nearly straight, curving downwards in front of the middle; inferior slightly sinuated in the middle. Seen from above, ovate-acuminate, widest near the posterior extremity, greatest width about equal to

the height; posterior margin indented in the middle at the junction of the two valves: end view nearly circular. Shell of the male somewhat more compressed, when seen from above, having the greatest width near the middle. The right valve much overlaps the left, especially in the middle of the ventral margin. Superior antennæ excessively short and stout, the joints much broader than long, except the last two and the first, whose breadth and length are nearly equal; all the joints except the first armed with very strong curved setæ, the longer of which are nearly equal in length to the last five joints of the antennæ, the shorter equal to the last two joints. Inferior antennæ also very short and stout; terminal claws nearly straight, with upturned extremities; last joint very short, with two stout, equal, apical spines; penultimate with three apical spines of equal length and one short seta, antepenultimate with one long and one rather shorter seta; basal joint thicker, having two slender setæ rising from independent bases. Joints of the second and third feet gradually decreasing in length from the first to the last; the longer of the two terminal claws equal in length to the three preceding joints; second and third joints armed on the posterior margins with several short sharp setæ or prickles. The shell is pellucid or milk-white, often slightly granular in appearance, and showing through it the limbs of the animal, as well as the ova and fully developed young. The infero-posteal angle of the shell is beset with a dense tuft of microscopic beaded hairs (fig. 14). Length $\frac{1}{32}$ inch.

Hab. Whittlesea Dyke, and on the site of Whittlesea Mere; the rivers Nene, Cam, Ouse, Deben, and Scheldt; Lake Lothing and Breydon Water; and the broads of Wroxham, Barton, Horsey, Hickling, Somerton, Ormesby, and Oulton.

A most extensively distributed and abundant species throughout the East-Anglian district, the only gathering in which we failed to find it being that from the river Bure, which it may be said was made under very unfavourable circumstances. Except in the river Scheldt, *P. Stevensoni* has not yet been found outside of this district, where its great abundance in many situations renders its apparently restricted habitat the more striking. This species, with *Goniocypris mitra* and *Metacypris cordata*, may be looked upon as the salient feature of the peculiar Fen fauna. We have much pleasure in dedicating it to Henry Stevenson, Esq., the accomplished author of the 'Birds of Norfolk,' to whose kind interest in the objects of our visit to the district we are indebted for much of our success.

TABLE I. *Distribution of Ostracoda.—Group* I. *River-estuaries, England and Scotland.*

	A. River Clyde.	B. Montrose Basin.	C. Budle Bay.	D. Warn Burn.	E. River Aln.	F. River Coquet.	G. River Wansbeck.	H. River Blyth.	I. River Ouse at Goole.	J. River Humber.	K. River Deben.	L. River Stour.	M. River Thames.	N. Fowey Harbour.
Cypris														
incongruens, *Ramdohr*	....	....	....	....	....	....	....	*						
fretensis, *nov. sp.*	....	....	....	....	....	....	....	....	....	....	*			
tumefacta, *nov. sp.*	....	....	....	**	....	*								
compressa, *Baird*	*	....	....	**	*	....	*	....	....	....	*	*		
ovum (*Jurine*)	....	....	....	**	*	....	....	*						
lævis, *Müller*	....	....	....	**	*	***	....	*	....	....	**			
reptans (*Baird*)	....	....	....	....	....	....	*	***						
gibba, *Ramdohr*	....	....	....	....	*	**	....	***	....	....	*	**		
Cypridopsis														
obesa, *Br. & Rob.*	*	....	....	....	*	....	....	*	....	....	....	**		
aculeata (*Lilljeborg*)	....	....	....	....	....	....	....	....	....	....	....	....	*	
Potamocypris														
fulva, *Brady*	*	*	....	**	*	**	*	*						
Candona														
candida (*Müller*)	....	....	....	**	*	***	*	***	....	....	**	**		
— *var.* tumida	....	....	....	**	....	....	*							
lactea, *Baird*	....	....	*	....	*	*	*	....	....	....	*	*	*	
albicans, *Brady*	*	....	....	*	*	*	....	....	....	....	*			
detecta (*Müller*)	*	....	....	....	*	*	?	*						
Pontocypris														
mytiloides (*Norman*)	....	*	....	....	*	....	....	....	....	....	....	....	*	**
trigonella, *G. O. Sars*	....	....	....	....	....	....	....	*	....	....	....	....	*	
acupunctata, *Brady*	....	....	?											
Cythere														
pellucida, *Baird*	*	....	**	....	*	....	***	***	**	***	....	....	***	*
castanea, *G. O. Sars*	**	**	**	*	**	*	***	***	***	**	**	**	**	*
porcellanea, *Brady*	*	**	***	....	**	....	***	***	***	**	**	....	***	
macallana, *B. & R.*	....	....	....	....	....	....	....	....	**	*	....	....	....	***
tenera, *Brady*	....	....	....	....	*	....	*	....	*	**	....	....	*	
lutea, *Müller*	....	*	....	....	....	....	*	....	....	....	*	*		

TABLE I. (*continued*).

	A. River Clyde.	B. Montrose Basin.	C. Budle Bay.	D. Warn Burn.	E. River Aln.	F. River Coquet.	G. River Wansbeck.	H. River Blyth.	I. River Ouse at Goole.	J. River Humber.	K. River Deben.	L. River Stour.	M. River Thames.	N. Fowey Harbour.
Cythere														
albomaculata, *Baird*	....	....	*	....	....	....	*	**	....	....	....	....	***	*
viridis, *Müller*	**	*	**	....	....	....	*	**	*	**	**	....	**	
convexa, *Baird*	....	....	....	....	....	....	....	....	....	....	....	....	*	***
villosa (*G. O. Sars*)	*	*	*	....	*	....	....	**	*	**	*	....	***	**
gibbosa, *B. & R.*	....	*	**	....	**	....	**	**						
cicatricosa, *G. O. Sars*	....	....	....	....	....	....	....	....	....	....	*	*	*	*
Robertsoni, *Brady*	....	*	*	....	....	....	?	....	....	*	....	....	*	*
fuscata, *Brady*	....	....	....	....	....	....	....	....	....	....	**	....	*	
tuberculata, *G. O. Sars*	....	....	....	....	....	....	....	....	....	....	....	....	*	
finmarchica, *G. O. Sars*	....	....	....	....	....	....	....	....	....	....	....	....	**	**
cuneiformis, *Brady*	....	....	....	....	....	....	*	*	....	....	....	....	....	**
fidicula, *nov. sp.*	....	....	?	....	....	....	....	....	....	....	....	....	*	
angulata (*G. O. Sars*)	*	....	....	....	....	....	....	*						
antiquata (*Baird*)	....	....	....	....	....	....	....	....	....	....	....	....	*	
Whiteii (*Baird*)	....	....	....	....	....	....	....	....	....	....	....	....	*	
semipunctata, *Brady*	....	....	*											
Limnicythere														
inopinata (*Baird*)	*	....	....	**	**	**	**	*	....	....	*	*		
Cytheridea														
papillosa (*Bosquet*)	*													
torosa (*Jones*)	....	....	....	....	....	....	*	***	*	....	*	**	**	
— *var.* teres	**													
lacustris (*G. O. Sars*)	....	....	....	....	....	....	....	....	....	....	....	....	*	
elongata, *Brady*	....	....	....	....	....	....	....	....	....	....	....	....	***	
cornea, *B. & R.*	....	....	....	....	....	....	....	....	*	*	....	....	*	
Eucythere														
declivis (*Norman*)	....	....	....	....	....	....	....	....	....	*	....	....	*	
Argus (*G. O. Sars*)	*	....	....	....	....	....	....	*	....	....	....	....	**	
Xestoleberis														
aurantia (*Baird*)	....	....	*	....	*	....	*	*	*	....	**	**	**	
depressa, *Sars*	....	....	....	....	....	....	....	....	....	....	....	....	....	***

Loxoconcha														
impressa (*Baird*)	....	....	....	....	*	....	....	....	....	....	**	*	**	***
elliptica, *Brady*	....	....	....	....	***	*	***	***	....	**	***	***	**	
tamarindus (*Jones*)	....	**	***	....	....	....	....	**	**	**	....	....	**	***
guttata (*Norman*)	....	....	....	....	....	....	....	....	....	....	....	....	**	
multifora (*Norman*)	....	....	*	....	....	....	....	....	....	....	....	....	....	*
fragilis, *G. O. Sars*	*	*	*											
pusilla, *nov. sp.*	....	**	**	....	....	....	**	**	....	....	*			
Cytherura														
nigrescens (*Baird*)	....	**	***	....	*	....	*	**	*	**	**	*	**	
similis, *G. O. Sars*	....	....	....	....	....	....	....	....	*	*	....	....	**	**
propinqua, *nov. sp.*	....	....	....	....	....	....	....	....	....	....	....	....	**	
flavescens, *Brady*	....	....	**	....	....	....	....	....	**	....	....	....	**	
cuneata, *Brady*	....	**	***	....	....	....	*	***	....	**	....	....	*	
striata, *G. O. Sars*	....	....	*	....	....	....	*	**	**	**	....	....	***	**
angulata, *Brady*	....	....	....	....	....	....	*	*	*	**	....	....	**	
Robertsoni, *Brady*	*	*	....	....	***	....	***	***	....	....	**	*		
gibba (*Müller*)	....	*	....	....	....	....	....	....	....	....	....	**		
simplex, *nov. sp.*	....	....	....	....	....	....	....	....	....	....	....	....	**	
producta, *Brady*	....	....	....	....	*	....	....	....	....	....	....	....	*	
undata, *G. O. Sars*	....	*	....	....	....	....	*	*						
acuticostata, *G. O. Sars*	....	....	....	....	....	....	....	*	....	**				
cellulosa (*Norman*)	....	*	**	....	*	....	*	**	**	**	....	....	**	*
Cytheropteron														
latissimum (*Norman*)	....	....	....	....	....	....	....	....	....	*	....	....	*	
nodosum, *Brady*	....	*	....	....	....	....	*							
Sclerochilus														
contortus (*Norman*)	....	....	....	....	*	....	**	*	....	....	....	....	*	*
Cytherideis														
subulata, *Brady*	....	*	*	....	*	....	*	***	....	*	....	....	**	
Paradoxostoma														
variabile (*Baird*)	*	*	*	....	*	....	**	***	*	*	....	*	*	
abbreviatum, *G. O. Sars*	....	....	**	....	*	....	*	*	....	*	....	....	**	*
ensiforme, *Brady*	....	....	....	....	....	....	....	*	....	**	....	....	***	
Fischeri, *G. O. Sars*	....	*	***	....	*	....	**	***	....	....	**	**	***	
hibernicum, *Brady*	....	....	**											
flexuosum, *Brady*	....	....	....	....	*	....	....	*	*	*	....	....	**	
Normani, *Brady*	....	....	*											
pulchellum, *G. O. Sars*	....	....	....	....	....	....	**							
Polycheles														
Stevensoni, *nov. gen. & sp.*	....	....	....	....	....	....	....	....	....	....	....	*		

TABLE II. *Illustrating the distribution of Ostracoda.—Groups* II. *and* III. *English Fen-district and Holland.*

	O. Site of Whittlesea Mere.	P. Whittlesea Dyke.	Q. River Nene.	R. River Cam.	S. Wroxham Broad.	T. Barton Broad.	U. Horsey Mere.	V. Hickling Broad.	W. Somerton Broad.	X. Ormesby Broad.	Y. Oulton Broad.	Z. Lake Lothing.	Aa. River Bure.	Bb. Breydon Water.	Cc.† River Ouse (Norfolk).	Dd.† River Scheldt.	Ee.† River Maas.
Cypris																	
virens (*Jurine*)	......	......	......	*													
obliqua, *Brady*	*	......	......	......	......	......	*										
ventricosa, *nov. sp.* ...	*																
fretensis, *nov. sp.*	*	......	......	......	......	......	......	......	*	......	......	**	......	**	......	*	
salina, *Brady*...........	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	
ovum (*Jurine*)	**	......	**	**	**	**	**	**	**	......	......	......	......	**			
lævis, *Müller*	**	*	**	**	*	**	......	**	*	......	*	*	......	*			
compressa, *Baird*	**	**	***	**	**	***	*	......	**	***	**	**	*	**	*	*	
striolata, *Brady*	......	......	......	......	......	*	......	?	......	*							
reptans (*Baird*).........	**	**	*	**	*	**	......	**	**	......	......	*					
serrata (*Norman*)	**	......	**														
gibba, *Ramdohr*	***	**	**	**	**	*	*	**	**	......	*	**	......	**	*		
Cypridopsis																	
vidua, *Müller*	**	......	**	**	**	*	......	......	......	*							
obesa, *B. & R.*	**	**	**	**	**	**	*	**	**	*	*	*	......	*	*	*	
aculeata (*Lilljeborg*) ...	*	......	......	......	......	......	**	**	*	......	*	......	......	**	......	*	
Newtoni, *nov. sp.*	**	......	**	*													
Metacypris																	
cordata, *nov. sp.*	......	......	*	*	*	**	......	......	......	......	......	......	......	**	......	*	
Potamocypris																	
fulva, *Brady*	*	......	**														
Candona																	
candida (*Müller*)	......	**	***	*	**	**	**	***	***	**	**	**	......	**	......	*	
— *var.* tumida	***	*	*	**	......	*	......	......	......	......	......	......	......	......	......	*	
lactea, *Baird*	**	**	**	**	**	**	*	**	**	**	**	*	......	*	*	*	*
detecta (*Müller*)	......	......	*	*	*	*											

albicans, *Brady*	**	**	**	**	**	***	*	......	*	*	**	*	......	**	*	*	*
compressa, *Koch*	***	*	**	**	**	*	**	......	*	*	*	*	......	**			
diaphana, *nov. sp.*	......	......	*	......	......	......	......	......	......	*							
Kingsleii, *nov. sp.*	......	......	*	......	......	**	*	*	......	......	......	......	......	**			
hyalina, *nov. sp.*	*	......	......	......	*	*	......	......	......	*							
Goniocypris																	
mitra, *nov. sp.*	*	**	*	*	**	*	......	......	*	**	......	......	......	......	*		
Notodromas																	
monachus, *Müller* ...	......	......	......	......	......	......	......	......	*								
Pontocypris																	
mytiloides (*Norman*)...	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*		
trigonella, *G. O. Sars* .	......	......	......	?	......	......	......	......	......	......	......	......	......	......	......	*	
acupunctata, *Brady* ...	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*
Argillœcia																	
cylindrica, *G. O. Sars*	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	* ?	
angusta (*Brady*)	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	
aurea, *nov. sp.*	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*		
Cythere																	
pellucida, *Baird*	*	......	......	......	......	......	......	......	......	......	......	......	......	*	*	*	*
castanea, *G. O. Sars* ...	**	......	......	*	......	*	......	......	*	*	**	***	**	**	*	*	*
porcellanea, *Brady* ...	*	......	......	......	......	......	......	......	......	......	*	......	**	***	*	*	*
tenera, *Brady*	*	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	*
viridis, *Müller*	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	*	*
cicatricosa, *G. O. Sars* .	......	......	......	......	......	......	......	......	......	*	......	*	**	**	......	*	*
fuscata, *Brady*	......	......	......	......	......	......	***	***	?	*	*	......	***	***	*	*	*
villosa (*G. O. Sars*) ...	......	......	......	*	......	......	......	......	......	......	......	......	......	......	*	*	*
finmarchica (*G. O. Sars*)	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	*
albomaculata, *Baird*...	......	......	......	......	......	......	......	......	......	......	......	......	*	......	*		
convexa, *Baird*	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	
fidicula, *nov. sp.*	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*
abyssicola (*G. O. Sars*)	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*		
Robertsoni, *Brady* ...	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*		
Stimpsoni, *Brady*......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	?	
emaciata, *Brady*	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*		
laticarina, *Brady*	......	......	......	?													
globulifera, *Brady* ...	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*		
antiquata (*Baird*)	......	......	......	......	......	......	......	......	......	......	......	......	*	*			

† In the last three columns we have not attempted to indicate the comparative frequency of the species.

TABLE II. (*continued*).

	O. Site of Whittlesea Mere.	P. Whittlesea Dyke.	Q. River Nene.	R. River Cam.	S. Wroxham Broad.	T. Barton Broad.	U. Horsey Mere.	V. Hickling Broad.	W. Somerton Broad.	X. Ormesby Broad.	Y. Oulton Broad.	Z. Lake Lothing.	Aa. River Bure.	Bb. Breydon Water.	Cc.† River Ouse (Norfolk).	Dd.† River Scheldt.	Ee.† River Maas.
Cythere																	
semipunctata, *Brady*...	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*		
acerosa, *Brady*	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	
Limnicythere																	
inopinata (*Baird*)	**	**	**	**	***	***	**	***	**	**	**	**	......	**	*	*	*
Sancti-Patricii, *B. & R.*	*	......	**	**													
monstrifica (*Norman*)..	**	*	......	*	......	......	......	......	......	......	......	......	......	*	*		
Cytheridea																	
torosa (*Jones*)	......	......	......	......	**	......	***	***	***	**	***	**	***	***			
— *var.* teres	**	......	......	*	......	**	***	***	***	**	***	**	***	***	*	*	*
lacustris (*G. O. Sars*)...	......	......	**														
elongata, *Brady*.........	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	
cornea, *B. & R.*.........	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	*
inæqualis, *nov. sp.*.......	......	......	......	*													
Eucythere																	
Argus (*G. O. Sars*) ...	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*		
declivis (*Norman*)......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	*
Xestoleberis																	
aurantia (*Baird*)	......	......	......	......	......	......	......	......	......	......	......	......	......	**	*	*	*
Loxoconcha																	
impressa (*Baird*)	......	......	......	......	......	......	......	......	......	......	......	**	......	*	*	*	*
elliptica, *Brady*	......	......	......	*	......	......	......	......	......	**	**	***	***	***	*	*	*
guttata (*Norman*)	......	......	......	......	......	......	......	......	......	......	......	......	*				
tamarindus (*Jones*) ...	......	......	......	*	......	......	......	......	......	......	......	......	......	......	*	*	*
pusilla, *nov. sp.*.........	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	
multifora (*Norman*) ...	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	
Cytherura																	
nigrescens (*Baird*) ...	*	......	......	......	......	......	......	......	......	......	......	**	......	*	*	*	*
similis, *G. O. Sars* ...	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	*
cuneata, *Brady*	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	*

flavescens, *Brady*	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	*	*
striata, *G. O. Sars*......	*	......	......	......	......	......	......	......	......	......	......	......	......	*	*	*	*
angulata, *Brady*	......	......	......	......	......	......	......	......	......	......	......	......	*	......	*	*	*
cornuta, *Brady*	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	
Robertsoni, *Brady* ...	*	......	......	......	......	......	......	*	......	*	**	*	**	**	*	*	*
undata, *G. O. Sars* ...	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	
producta, *Brady*	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	
acuticostata, *G. O. Sars*	*	......	......	......	......	......	......	......	......	......	......	......	......	......	*		
cellulosa (*Norman*) ...	......	......	......	......	......	......	......	......	......	......	......	......	*	......	*	*	*
clathrata, *G. O. Sars*...	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*		
Cytheropteron																	
latissimum (*Norman*)...	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	
nodosum, *Brady*	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*		
subcircinatum, *G. O. Sars*	......	......	......	......	......	......	......	......	......	......	......	......	......	......	* ?	*	*
rectum, *Brady*	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*
Cytherideis																	
subulata, *Brady*	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	*	*
Sclerochilus																	
contortus (*Norman*) ...	......	......	......	......	......	......	......	......	......	......	*	......	......	......	*	......	*
— *var.* abbreviatus ...	......	......	......	......	......	......	......	......	......	......	......	......	......	**	......	*	
Paradoxostoma																	
variabile (*Baird*)	*	......	......	......	......	......	......	......	......	......	......	**	*	......	*	*	*
abbreviatum, *G. O. Sars*	......	......	......	......	......	......	......	......	......	......	......	......	......	**	*	*	
ensiforme, *Brady*	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	*	*
Fischeri, *G. O. Sars* ...	*	......	......	......	......	......	......	......	......	......	......	**	**	***	*	*	*
flexuosum, *Brady*	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*	*	*
arcuatum, *Brady*	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	*
Polycheles																	
Stevensoni, *nov. gen. & sp.*	**	*	**	**	**	**	**	***	**	***	*	*	......	**	*	*	
Polycope																	
compressa, *B. & R.* ...	......	......	......	......	......	*											

† In the last three columns we have not attempted to indicate the comparative frequency of the species.

II.—*On the use of the term Homology in modern Zoology, and the distinction between Homogenetic and Homoplastic agreements.* By E. Ray Lankester, B.A. Oxon.

Whilst the adoption of the theory of evolution has broken down the notions at one time held by zoologists and botanists as to the existence of more or less symmetrical classes and groups in the organic world, established by some inherent law of Nature which limited her productive powers to arbitrary special plans or types of structure, and has taught us to see, in the variously isolated and variously connected kinds of animals and plants, simply the parts of one great genealogical tree, which have become detached and separated from one another in a thousand different degrees, through the operation of the great destroyer Time, yet certain terms and ideas are still in use which belonged to the old Platonic school, and have not been defined afresh in accordance with the doctrine of descent. The notion of the possibility of classifying organisms accurately by means of division into large groups of equal value and significance, these again being divided into smaller groups of equal subordinate value, and so on, is still almost universally prevalent, although one of the first conclusions to which we are led by a consideration of Darwin's doctrine is that the groups into which we may be able to cast the few and scattered samples of organic development known to us must be in every way most unequal and dissimilar, the line which we can draw in one case being sharp and clear, in another much less certain and definite, sometimes including a vast variety of minor groups, sometimes embracing definitely marked large groups, in no case offering us examples of two series of forms strictly alike in extent and significance; and thus it is rendered impossible to indicate the genetic relations of organisms by the use of the neat and symmetrical system of terms generally employed (consisting of kingdom, subkingdom, class, order, family, &c.). To do this adequately, additional terms are required (and, indeed, have been proposed), and the important fact has to be held in mind that we have not to search out a supposed symmetrical disposition of organisms existing in nature, but to simply indicate as clearly as we can the sequence of forms and the innumerably various gaps in the series.

The term "homology" belongs to the Platonic school, but is nevertheless used without hesitation by those who reject the views of that school. Professor Owen (who first clearly defined this term, in developing those researches into the agreements of essential structure under various modifications by which the biologists of the first part of this cen-

tury so much advanced science) would understand by *homologue* "the same organ in different animals under every variety of form and function;" by *analogue*, "a part or organ in one animal which has the same function as another part or organ in a different animal." But how can the sameness (if we may use the word) of an organ under every variety of form and function be established or investigated? This is, and always has been, the stumbling-block in the study of homologies without the light of evolutionism; for, to settle this question of sameness, an ideal "type" of a group of organisms under study had to be evolved from the human mind, after study of the component members of the group; and then it could be asserted that organs might be said to be the "same" in two animals which had a common representative in the ideal type.

This reference to an ideal type was the only criterion o homology; and yet we find those who have adopted the doctrine of evolution making use of the term "homology" without any explanation. The study of homologies was brought under a very important influence from the appreciation of the value of developmental changes in indicating the similarities or distinctions of organs; and before the appearance of Mr. Darwin's theory many zoologists were turning to embryology as a surer guide than ideal archetypes in tracing the identities of structure in organisms; so that, refusing to commit themselves to the Platonic theory, they were ready to receive the flood of light and explanation which the doctrine of descent shed upon the meaning and nature of homologies.

What, then, are we to suppose that an evolutionist means when he asserts that an organ A in one animal is homologous with an organ B in another animal? It is clear that he cannot consistently have the same meaning as a Platonist; and yet it appears that, from the force of habit or some accidental cause, the term homology *is* used at the present time in the old sense by many authors who accept the doctrine of evolution, or at any rate not with any definite meaning which has been agreed upon by those who belong to the new school.

Without particularizing the authors whose views are alluded to, we may mention the attempt to trace the *homologies* of the bones of the skull in detail through the vertebrate series, the *homology* of the chain of nerve-ganglia of Arthropoda with the sympathetic of Vertebrata, the *homology* of the four cavities of the heart and also of the individual muscles of the limbs in Sauropsida and Mammalia, and especially the so-called *serial homologies* of the fore and hind limbs in Vertebrata and of the teeth of the upper and lower jaws.

Without doubt the majority of evolutionists would agree that by asserting an organ A in an animal α to be homologous with an organ B in an animal β, they mean that in some common ancestor κ the organs A and B were represented by an organ C, and that α and β have inherited their organs A and B from κ. Though this is the definition of homology which we should expect from an evolutionist, it is yet not that which seems to be implied in the cases above cited; and on investigation it appears that there is something more contained in the Platonist's term "homologue," which must be separated and distinguished from the idea of genetic community of origin. It will be found, in fact, necessary to have two terms in place of the one "homologue," and to broadly distinguish the nature of the resemblances to which they are applied. Structures which are genetically related, in so far as they have a single representative in a common ancestor, may be called *homogenous*. We may trace an *homogeny* between them, and speak of one as the *homogen* of the other. Thus the fore limbs of Mammalia, Sauropsida, Batrachia, and Fishes may be called, so far as their most general structure is concerned, *homogenous*, but only so far as relates to general structure; for if we endeavour to trace these groups back to a common ancestor, we find that, by the time that ancestor is reached, the limb has become a very simple form, and that which Mammalia, Sauropsida, Batrachia, and Fishes have inherited from this common ancestor is but the rude outlines of an appendage: it is only thus far that their limbs can be called homogenous. If, however, we compare the fore limb of Sauropsida and Mammalia, it is possible to go a step further with the homogeny; for the common ancestor of these groups we may suppose to be (for the sake of illustration) among the immediate ancestors of the Batrachia; and so far as the fore limbs of Mammalia and Sauropsida present evidence of that simple skeleton and system of muscles which we have reason to believe their præ-Batrachian ancestor possessed, we may assert their homogeny, but no further: details not traceable to and inherited from the ancestor cannot be homogenous. And now, if we turn to the examples of structures whose homologies have been recently discussed by writers who, there is good reason to believe, accept the doctrine of evolution, we shall see that in tracing *homologies* they are not confining themselves to the elucidation of what it is here proposed to term *homogenies*. Since, in all probability, the Vertebrata have diverged from the stock which gave rise to the Arthropoda at a point in the series where the nervous syste mis of the simplest and most rudimentary kind, it is only to a small

extent that there is homogeny between the chain of nerve-ganglia of Arthropods and the sympathetic ganglion-system of Vertebrata—merely an agreement which is so general that we can only say that the nervous system as such in the two cases is in the most general way homogenous, and must seek for some other cause to account for the more detailed resemblance of the insect's nerve-chain to the vertebrate sympathetic. In this case we see that in discussing so-called "homology," two kinds of relation have been in question. Again, it may perhaps be admitted that the common ancestor of the osseous Fishes and Mammalia had a skull of decidedly undifferentiated character, with a much less amount of segmentation than is observed in the skulls of either of these groups. It is only in so far as they have parts represented in the common ancestor that we can trace *homogeny* in these groups; and yet the *homology* of a vast number of bones in the skulls of the two is discussed and pointed out. In particular may be mentioned the mammalian incus, malleus, and other parts in their region which have been identified homologically with *particular* bones in the suspensorium of the lower jaw of the fish. It will be allowed that the *homogeny* is of a much less detailed kind, and will only admit of the assertion of a genetic relation between the *regions* in which these bones arise, the particular result of segmentation in each case being *not* homogenous, since the common ancestor of osseous fish and mammalia was in all probability a fish in which segmentation of the lower jaw and suspensorium had been carried to a very small extent. So, too, with regard to the homologies of the same bones with the Sauropsidan suspensorium*. The homogenetical agreement can be one of no greater detail than is indicated by the condition of this region in the supposed common ancestor of Mammalia and Sauropsida; and it does not appear probable that the incus and malleus, or the quadrate and articulare, were represented by similarly segmented bones in their common ancestor. To take another case, the four cavities of the bird's heart are generally regarded as homologous with the four cavities of the mamma-

* The supposed cases of homology here given are used to illustrate the principle under discussion. The latest views which have been advanced by Prof. Huxley on the homologies of the malleus and incus and neighbouring parts are acceptable if we recognize homogeny, since he dwells rather on the identity of the cartilaginous arches than on the correspondence of individual segments; but I am not sure that he means to speak of homogenetic relation when he says, "The operculum and suboperculum (of fishes) together answer undoubtedly to potential hard parts in the mammalian concha of the ear" (Brit. Med. Journ. (Abstract) 1869, p. 375).

lian heart; but since the common ancestor of mammals and birds in all probability had but three cavities to its heart, the ventricles are only *homogenetic* as a whole, and not each to each. The disposition of the aorta and the important light thrown on the origin of the muscular right auriculo-ventricular valve of the bird's heart by comparison with an Ophidian or Lacertian heart, harmonize decidedly with the conclusion that the right ventricle of the bird is not homogenetic with the right ventricle of the mammal. But it is said to be homologous. Why? What is there more involved in the term homology which here, again, as also with regard to the bones of the skull, is not implied in the term homogeny? When it is sought to establish a detailed homology between the muscles of the pectoro-humeral region in Mammalia, Birds, and Reptiles (as, for instance, is done by my friend and teacher, Professor Rolleston, who concludes that the mammalian subclavius is the homologue of the pectoralis secundus of the bird, and of the epicoraco-humeral of the Iguana, and the mammalian coraco-brachialis longus of the pectoralis tertius of the bird and of the middle part of the coraco-brachialis of reptiles), we surely are not to understand that these muscles are homogenetic, that the common ancestor of Mammalia and Sauropsida possessed all these muscles, and has transmitted them to its descendants. The common stock of these groups most certainly had not such a specialization of this part of its muscular structures. What, then, is it that produces so close a resemblance in the disposition of these parts as to lead one to speak of homology? What is the other quantity covered by the term homology over and above homogeny?

The consideration of one more case, that of serial homologies, will bring us to this: Unless it be maintained that the vertebrate animal is an aggregate of two individuals, one represented by the head and arms, the other by the legs, no genetic identity can be established between the fore and hind limbs. And since no one will maintain such a constitution for the Vertebrata (though it is exceedingly probable that the earliest segmentation which they exhibit is a remnant of such a history), the possibility of serial homogeny is out of the question in Vertebrata, though the segments of Arthropoda, Vermes, and other tertiary aggregates present it. And yet we speak of serial homologies; and it is possible to trace a very remarkable correspondence between the bones and muscles of the fore and hind limbs. What is the nature of the correspondence between fore and hind limb which is called "serial homology?" If we can ascertain this, we may expect to ascertain at the same time the nature of the correspondence

which is not homogenetic and yet is recorded as "homology" in the study of the cranial bones, of the bones and muscles of the extremities, and of other organs. The answer to this inquiry appears to be found in the following considerations. When identical or nearly similar forces, or environments, act on two or more parts of an organism which are exactly or nearly alike, the resulting modifications of the various parts will be exactly or nearly alike. Further, if, instead of similar parts in the same organism, we suppose the same forces to act on parts in two organisms, which parts are exactly or nearly alike and sometimes homogenetic, the resulting correspondences called forth in the several parts in the two organisms will be nearly or exactly alike. There will be, I imagine, no kind of difficulty to the evolutionist or student of Mr. Herbert Spencer's writings in admitting the above propositions; and it is in accordance with the principle they set forth that serial homologies and much else which, together with what is here distinguished as homogeny, has been included under homology may be explained. I propose to call this kind of agreement *homóplasis* or *homóplasy*. The fore legs have a homoplastic agreement with the hind legs, the four extremities being, in their simpler form (e. g. *Proteus*, which must have had ancestors with quite rudimentary hind legs), very closely similar in structure and function. To a very considerable extent the movement and support required from the fore and hind limbs in subsequent developments of this stock, whether towards Mammalia or Sauropsida, would be the same; and hence the muscular and skeletal parts would agree in many striking details, these details serving as the groundwork for further modifications when the character of a flying, grasping, or offensive organ was assumed by either pair of extremities*. The muscles of the pectoro-humeral region are homogenetic in a general way in mammals and Sauropsida; but such details of agreement as that between the pectoralis major of mammals and the gracilis of *Iguana*, the subclavius and the deeper head of the pectineus, the coraco-brachialis and part of the obturator externus, we must set down to the fact that they are to a great degree homoplasts,—similar forces or require-

* The concomitant variation of fore and hind limb in such matters as feather-growth seems to point to a somewhat closer relation between these parts; but it is quite conceivable that such a nutritional relation should arise in the course of time by a sort of delicate balancing of the forces of the organism, which would cause the disturbance of equilibrium in one part to affect simultaneously another part equally and similarly. Organs which stand in this nutritional relation to one another may be termed homotrophic; such are teeth and hair, eyes and ears, and others enumerated by Mr. Darwin, as well as fore and hind limbs.

ments operating on similar materials in the two stocks, the Mammalian and Sauropsidan, having produced results in the way of structure which have a certain agreement. What, exactly, is to be ascribed to homogeny, and what to homoplasy, in the relations of this series of structures, is a matter for careful consideration. As was remarked above, the right ventricle of the bird's heart is not homogenous with the right ventricle of the mammal's heart, nor the left with the left; but the two cavities in each case are homoplastic—the same conditions as regards the maintenance of animal heat and other matters belonging to the circulation, which evoked or were the cause of the perpetuation of this structure in the one case having equally operated in the other. As to the bones of the skull, the room for diversity is not very great when the homogenous basis is given which all higher Vertebrata have inherited from a common ancestor; but there can be no doubt that many of the bones in the fish's skull are not homogenous with those of other Vertebrata, whilst they appear to be related as homoplasts. That similar forms may arise in this way in the skulls of two divergent stocks, and lead to close correspondences which are not traceable to homogeny, is indicated by the fact that membrane-bones corresponding in position and relations in the skulls of one group to cartilage-bones in the skulls of another group are observed*. The membrane-bone in this case is certainly not homogenous with the cartilage-bone; but it is homoplastic with it; and in the same way it is very probable that membrane-bones in two skulls are in some cases only homoplasts, though they may have been the subject of speculation as to their homology. The mammalian malleus and mandible present an homogeny of the general region only, when compared with the bones of the suspensorium and lower jaw of the fish, the individual bones of which, as well as the opercular bones, are not represented in the mammalian skull by corresponding individual bones, and not even by homoplastic developments. The Sauropsidan suspensorium, in being segmented, presents a closer homoplastic agreement with that of osseous fish; and probably a true homogenetic correspondence is to be admitted in the quadrato-articular articulation of Fishes and Sauropsida.

It may be said that the term "analogy," already in use, is sufficient to indicate what is here termed "homoplasy;" but analogy has had a wider signification given to it, in which it is

* As an example, the cartilage-bone in the fish's skull, which Mr. Parker proposes to call pterotic, till lately considered the homologue of the squamous in mammals, may be cited.

found very useful to employ it, and it could not be used with any accuracy in place of homoplasy. *Any* two organs having the same function are analogous, whether closely resembling each other in their structure and relation to other parts or not; and it is well to retain the word in that wide sense. Homoplasy includes all cases of close resemblance of form which are not traceable to homogeny, all *details* of agreement not homogenous, in structures which are broadly homogenous, as well as in structures having no genetic affinity.

There may be other less direct causes at work in producing homoplasy besides an agreement in environment or external evoking conditions; such a cause is indicated in the remarkable cases grouped by Mr. Darwin as correlations of growth, and for which the term *homotrophy* may perhaps be found useful.

An illustration of the distinction between homoplastic and homogenetic agreement in form may be seen in the possible origin of the forms of the weapons and utensils of various races of men. Two races, A and B, without communication, *may* devise a stone axe or a canoe of similar form: the resemblance is in this case homoplastic. The inventors have learnt in the same school, indeed; but that school is the school of necessity, as Professor Huxley once observed with regard to the Indian stone implements. In the course of time the axe or canoe is improved on and perfected in various ways by the race A, and this particular form of instrument becomes widely spread and slightly modified in various branches of the race. The various modifications are all homogenous, traceable as they are to one original pattern which has been improved upon. They have, however, still merely a homoplastic agreement with the instruments of the race B, which may have become similarly improved.

Besides the cases of simple homoplasy which have not been discriminated from homogeny, but indicated under the common term homology, there are others which may be cited, which have less commonly or never been accounted for by calling them cases of homology. Among the simplest of these, we have the jointing of an appendage, such as the antenna of an insect and of a crustacean, the individual joints of which are homoplastic, though they have never been considered homologous—or, again, the calcareous shell of a cirripede and a multivalve mollusk, which are to a great degree homoplasts, though their homology has not been maintained for many years. The beak of a bird is to a considerable extent homoplastic with the beak of a chelonian, the dorsal and caudal fins of a cetacean with those of some fish, the setæ of *Acan-*

thobdellea with those of Chætopods; but zoologists would hesitate to assert homology in these cases, and it certainly seems improbable that there is homogeny. What Mr. Spencer calls "superinduced segmentation," hitherto included by many zoologists as serial homology, falls under simple homoplasy, the detailed resemblances of the vertebræ being thus explained, though it is possible that there is an obscured homogenous segmentation indicated in the earliest stages of vertebrate development.

I trust now to have said sufficient to illustrate the distinction which I wish to draw between homogeny and homoplasy, and to have shown a probability that a good deal of the latter has been associated with the former under one head, "homology." It is less likely to cause confusion if we have a new term than if we amend an old one, which is my reason for not retaining "homology." It is not improbable that homoplasy may admit of further analysis; but it is sufficient here to distinguish it from homogeny. I do not propose to defend against criticism the cases I have used in illustration. The views suggested with regard to particular cases are open to much discussion, and the views alluded to as being commonly held may in some instances be not very widely prevalent. This, however, does not affect the matter in hand. Concrete cases are given merely with a view to illustration, and to render clear what is the relative significance of the terms "homology," "homogeny," and "homoplasy."

What is put forward here is this,—that under the term "homology," belonging to another philosophy, evolutionists have described and do describe two kinds of agreement—the one, now proposed to be called "homogeny," depending simply on the inheritance of a common part, the other, proposed to be called "homoplasy," depending on a common action of evoking causes or moulding environment on such homogenous parts, or on parts which for other reasons offer a likeness of material to begin with. In distinguishing these two factors of a common result we are only recognizing the principle of a plurality of causes tending to a common end, which is elsewhere recognizable and has been pointed out in biological phenomena. The explanation of the phenomena by the one law of homology is a part of that tendency to view Nature as more simple and more easily mastered than she really is, against which Bacon cautions us.

I am persuaded that some valuable results may be obtained from an investigation of the numerous problems of homology by the light which the discrimination of homogenous and homoplastic formations can afford. The discrimination is a

matter of time and labour, but is feasible. Besides the homologies of the vertebrate skeleton and muscles, I would mention the various vascular systems of the Invertebrata as likely to be better understood in this manner. The vascular system of leeches, with its hæmoglobin, is not homogenous with that of Chætopods, though closely homoplastic with it: its relation to the nervous system, segment-organs, its development, and the probable ancestral relations of the Leeches and Trematodes lead to this conclusion. Yet most zoologists would consider these two vascular systems homologous, or perhaps only qualify the term by refusing to regard them as *strictly* homologous.

Again, the hæmochyle or blood-lymph system of Vertebrates has no homogen, or but a very rudimentary one, in the other groups of animals. The vascular fluid of mollusks and insects has a homoplastic agreement with one part of the vertebrate hæmochyle, viz. the lymph, whilst the hæmoglobin of annelids and of the plasma of some insects' and mollusks' vascular fluid corresponds functionally with the red corpuscles.

Another distinction, of more importance, which a consideration of homogeny and homoplasy suggests, relates to the segmentation in various groups of the Annulosa. Leaving the question as to the origin of this segmentation, by arrested gemmation or otherwise, on one side, we are led to conclude that in any case such repetition is not necessarily a proof of affinity, is not necessarily homogenous in the animals compared, but may be simply homoplastic. The Annelida, on the one side, and the Arthropoda, on the other, are probably entirely unrelated, so far as their segmentation is concerned, each having sprung from a distinct unisegmental ancestor, the primitive Annelidan and Arthropodan having been possibly very little alike, even in their unisegmental stage, and having only a more remote ancestral connexion, difficult to conjecture. Thus, then, the ganglion-chain of the two groups, and their points of contact in tegumentary development, sense-organs, &c., are simply homoplastic, and not homogenous.

Zoology has been for some time embarrassed with the reference of all segmented Invertebrata to a common type, and the supposed homology of their segmented structures. This difficulty may, it is suggested, be possibly solved by the admission of true zooid-segmentation as being frequently due to homoplasy, and not by any means necessarily an indication of genetic affinity.

III.—*List of Coleoptera received from Old Calabar, on the West Coast of Africa.* By Andrew Murray, F.L.S.

[Continued from vol. v. p. 438.]

[Plates II. and III.]

Pachydissus, Newm.

1. *Pachydissus femorellus*, Chevr. Rev. et Mag. de Zool. 1856, p. 340.

Obscure cinereus; capite ovato, pilis brevibus aureis antice posticeque induto, versus thoracem minutissime tuberculato, sulco longitudinali in fronte valde impresso; palpis, mandibulis, labio, clypeo primoque articulo antennarum (valido clavato scabro sulcatoque) nigris; oculis subcontiguis, amplis, supra profunde emarginatis; antennis corpore vix longioribus, articulis elongatis, 5–10 ad apicem subangulatis; thorace subrotundato, antice posticeque constricto, transversim grosse plicato, pilis aureis dense vestito, sed in parte dorsali nigro (ad latus anterius cum tuberculo magno); scutello triangulari; elytris punctulatis ad humerum rectangule subrotundatis, ad apicem oblique truncatis; spina suturali acuta; femoribus cinereo-ferrugineis, longitudine costulatis.

Long. 8–13 lin., lat. $1\frac{3}{4}$–$3\frac{1}{2}$ lin.

Brownish black, covered with a short, ashy-grey, velvety pubescence, except on the head, thorax, and tarsi, where it is replaced by silky, irregularly interrupted, brownish golden hairs. Head strong, deeply channelled above. Eyes very projecting, making the head at its widest nearly as broad as the widest part of the thorax, coarsely granulated, strongly emarginate above, and almost touching each other; a golden brownish-yellow pubescence both in front of and above the eyes and on the front of the head. Labrum piceous. Palpi and mandibles black. Antennæ in the males about a fourth or a fifth longer than the body, in the females very little longer; with the first article thick, punctate, pitted, with a shallow channel on the upperside, blackish, the remaining articles elongated, and those from the fifth to the tenth inclusive somewhat angulated at the apex. Thorax rounded, constricted in front and behind, covered with large, short, transverse folds, which are interrupted by oblique channels, producing a sort of coronet-shaped space a little before the base on the posterior part of the disk, which is black and free from pubescence, as is a narrower dorsal middle space continuing on to the front of the thorax; the yellowish-golden pile occurs in patches on the rest of the thorax—one at the base in front of the scutellum, one on each side a little behind the middle, and one on each

side nearer the front and not so far apart, others on the side near the anterior and posterior angles; near the anterior margin, on the side, is a large tubercle, and a smaller one a little behind and further from the side, a longitudinal channel leading from the one to the other. Scutellum triangular and impunctate. Elytra flattened, parallel, of the breadth of the thorax, truncated at the apex, each with two spines; their surface has a dull opaque ground, and is covered in the middle with small, scattered, shallow punctures; these become very few and fine towards the base, and wholly disappear towards the apex; clothed with a fine, hoary-grey, velvety down, changing its reflections in different lights. Legs rather long; the thighs reddish or brownish red, and feebly keeled on the inferior margin; underside blackish, clothed with the same hoary pile. Abdomen with five abdominal segments.

Very few specimens have been received, but their size has been very various.

2. *Pachydissus dilatatus*, Chevr. Rev. et Mag. de Zool. 1856, p. 567.

Sericeo-luteus; palpis, antennis pedibusque ferrugineis; oculis amplis, nigris; thorace elongato, antice valde et postice late attenuato, stricto et recto, in lateribus et in medio fusco, longitudine inæquali et subplicato; elytris minute punctatis, ultra medium infuscatis, subito dilatatis, dein obliquis, et apice recte truncatis.

Long. $4\frac{1}{2}$–5 lin., lat. 1 lin.

One of the smallest species of the genus, silky, and of a pale cinnamon-colour. Head strong, rounded, with a short pile, reddish and somewhat rugose only on the posterior part. Eyes large, black, almost united behind, deeply emarginate above. Mandibles obscure. Antennæ ferruginous, with the first article thick, rounded, the third a little longer than the fifth, the sixth equal to the third. Thorax at least twice as long as broad, very attenuated, margined and straight in front, more broadly behind, unequal, and with short transverse folds in the middle; its colour is brownish black, with two longitudinal lines and the middle in front silky; a lateral ridge borders the silky part; the sides are rounded. Scutellum of an obscure ash-colour, rounded triangular. Elytra a little broader than the thorax, nearly three times as long, shortly rounded on the outside of the shoulder, parallel for two-thirds from the base, suddenly widened and narrowing obliquely afterwards, and then truncate at the extremity; they have a punctured space, and a small, oblique, blackish line in the

middle of the elytra near the dilatation; the margin at that place is also obscure. Abdomen of an obscure silky grey, of five segments, which are nearly equal, but which diminish in size towards the extremity.

This was not among the species which came to me from Old Calabar; it was procured by Mr. Hislop, and by him communicated to M. Chevrolat, in whose collection (now in the British Museum) it now is.

ALLOGASTER, Thomson.

Allogaster annulipes. Pl. III. fig. 2.

Corethrogaster annulipes, Chev. Rev. et Mag. Zool. (1855) p. 183.

Cinnamomeus; capite rotundato, anguste sulcato, genis late nigris; antennis flavis, palpis rufis; thorace in dorso septemtuberculato, lateribus obtuse unidentato; elytris acupunctatis, duabus lineolis obsoletis costiformibus, postice rotundatis et parce fulvo setosis (fœmina).

Long. 11 lin., lat. 4 lin.

Pale cinnamon-coloured, with the apex of the thighs black. The figure given in Plate III. renders it unnecessary to say more by way of description.

Rare. In the British Museum and my collection.

An African form, the only other species being from Senegambia.

DIASTELLOPTERUS, Thoms.

Diastellopterus clavatus.

Paristemia clavata, Chevr. Rev. et Mag. Zool. (1855) p. 513.

Alatus, crebre punctatus, luteo-fuscus; oculis, antennis (primo articulo fulvo, tertio dilatato), pedibus, pectore abdomineque nigris; elytris costulis octo.

Long. 6½–7 lin., lat. 3 mill.

Only one example. The species ranges from Old Calabar to Gaboon.

PARISTEMIA, Westw.

Paristemia apicalis, Westw. Arcana Ent. ii. p. 57, pl. 64. fig. 2 ♀, var. *costata.*

The Old-Calabar specimens are a little broader and stouter, and the lateral tubercle on the thorax stouter and straighter, than those from Sierra Leone. The tubercle in the Sierra-Leone specimens which I have seen has a very slight tendency to look backwards, which is not the case in the Old-Calabar individuals. At first I distributed specimens under the name of *P. costata*, which has led Prof. Lacordaire (Gen. Col. ix. p. 162)

to say that a third species is known in collections under the name *costata*, Murray; but I am now satisfied that the differences are not specific, and that it is only a climatal variety.

I cannot agree with Prof. Lacordaire in placing this species in the same genus as the preceding (*Diastellopterus*). The different form of the thorax and the different facies of the whole animal seem to call for the erection of a different genus for each. Similar reasons lead me to preserve the genus *Amphidesmus* of Serville for the Brazilian species of this type of Longicorns, instead of sinking it in *Paristemia* of Westwood as Lacordaire has done. I preserve that name for the West-African form, to which it was originally applied by our great English entomologist.

It appears to me, too, that the relations of affinity of this genus and its allies are greater with the Lepturidæ (*Desmocerus* &c.) than with any other group; and I have placed them accordingly where, thanks to Prof. Lacordaire, it seems now generally admitted that that group ought to be taken in.

This is another instance of affinity between Brazilian and West-African species.

CALLICHROMA, Latr.

1. *Callichroma afrum*, auct.

Cerambyx afer, Linn. Mantis. Plantar. p. 532; Drury, iii. 1. pl. 39. fig. 4.
—— *ater*, Fab. Syst. El. ii. p. 268.

Occasional.

This species seems to range all along the coast from Senegal to Old Calabar. It belongs to a type which is especially characteristic of Brazil and West Africa. The smallest species of the genus, and distinguished by the elytra rapidly attenuated behind, the light-green opaque elytra, bright golden suture, and red legs. *Callichroma* assumes a number of different forms and facies; and although it is impossible to find good generic characters by which to define them, the eye can easily detect and separate them. *C. afrum* and its allies, which follow, are of this character; and I claim them as instances of the extension of Brazilian species into Africa or of the converse.

2. *Callichroma calcaratum*, Chevr. Rev. et Mag. d. Zool. 1856, p. 341.

Affine *C. albitarsi*, attamen latius et brevius, viridi-lætum, nitidiore in marginibus thoracis suturaque; palpis, antennis pedibusque ferrugineis, femoribus infra emarginatim calcaratis et abrupte clavatis, posticis elongatis; capite punctato, longitudine sulcato; thorace transversim plicato, angulose

dentato; scutello acutissimo; elytris creberrime rugulosis; corpore infra viridi, segmentis abdominalibus infra anguste fuscis.

Long. 12½ lin., lat. 3¼ lin.

Belongs to the same type as *C. afrum*, and near *Callichroma albitarse*, but shorter and proportionally broader at the shoulders, of a green more or less tender and brilliant, obscure on the margin of the elytra, and brighter on the suture and on the scutellum and anterior and posterior sides of the thorax. Antennæ and legs ferruginous, tarsi paler. Head narrow, brilliant, very finely punctate in front, very densely in the middle and behind; three longitudinal channels in front, and a transverse one between the eyes. Labrum emarginate, obscure ferruginous. Mandibles elongate, conical, green, and rugosely punctate at the base, black and smooth towards the tip, a little sinuated on the inner side. Eyes black. Thorax as long as broad, straight, and bordered in front and behind with a basal fold situated between two transverse grooves, lightly convex and flattened on the disk, and with four obtuse tubercles. The disk is finely rugulose, and has some transverse or oblique wrinkles; lateral spine stout, obtuse, brilliant, and irregularly punctate. Scutellum very pointed. Elytra of an obscure and velvety green, very densely and finely rugulose, more coarsely wrinkled and punctate behind the scutellum; they are broad and rounded on the shoulders, and diminish by degrees to the apex of the suture. Body below of a brilliant green with whitish pubescence; posterior margin of the abdominal segments obscure ferruginous. Posterior thighs with a very slight tooth on the underside near the apex, caused by a feeble emargination (female).

Apparently rare. In my collection.

3. *Callichroma simulatum*, Chevr. Rev. et Mag. d. Zool. 1856, p. 342.

C. calcarato simillimum, sed differt statura minore, antennis gracilioribus et femoribus clavatis, sed non dentatis; viridiprasinum; capite rugose punctato, antice trisulcato; thorace vage punctato, in dimidia parte postica arcuatim rugato acutius spinoso; elytris rugulosis, subparallelis, ad suturam flavido-sericeis.

Long. 9 lin., lat. 2¼ lin.

Belongs to the same type as *Callichroma calcaratum*, and is very like it in colour, but smaller, with more slender antennæ and thighs, not dentate, of a fine tender vegetable-green. Head more strongly and somewhat rugosely punctate in front,

otherwise marked nearly as in *C. calcaratum.* Mandibles shorter, green at the base, black at the point. Palpi, antennæ (first article somewhat obscure), and legs ferruginous. Thorax straight, constricted, bordered and brilliant on the anterior and posterior margins, with a small basal fold, faintly punctate and smooth behind the head; arched wrinkles cover the posterior two-thirds; the sides are polished, slightly bluish, and the lateral spine, although tolerably stout, is sharper. Scutellum triangular, punctured, and golden; it has a channel in the middle, and two small depressions in front. Elytra subparallel, rounded on the shoulder, and a little more narrowly at the apex, finely rugulose and longitudinally faintly impressed with the remains of one or two depressed lines; suture entirely of a yellowish green. The four anterior thighs are abruptly swollen; and the posterior are long, flat, and gradually thickened. Body below of a clearer green, and covered with a whitish pubescence; the margins (both anterior and posterior) of the abdominal segments are narrowly blackish. Pygidium subconical, black, green only at the extremity (female).

Apparently not common. In my collection.

4. *Callichroma obscuricorne,* Chevr. Rev. et Mag. d. Zool. 1858, p. 52.

Simillimum *C. afro,* Linn., differt ab illo statura, capite, thorace elytrisque brevioribus; his ad apicem latiusculis, subparallelis, in sutura aureo-viridibus, necnon albicantibus. Alatum, punctatum, viride; capite antice subquadratum, ad latera sulcato et marginato, vage et fortiter punctato, sulco frontali longiore; palpis, labio pedibusque rubris; mandibulis apice, oculis antennisque nigris; thorace transverso, rugis integris parvis tecto, punctulato, antice posticeque recto et late constricto, ad basin canaliculato, aureo, costula recta superposita, spina laterali validiuscula, acuta; scutello triangulari, producto, aurato; elytris viridi-obscuris, singulatim rotundatis; pectore et abdomine viridi-albicantibus, subsericeis.

Long. 9 lin., lat. 4 lin.

This species has much resemblance to *Callichroma afrum,* Linn., but may be distinguished by the following differences:—Altogether the head, thorax, and elytra are shorter; the latter are parallel, and do not become more attenuated posteriorly, and, instead of being green passing into whitish, are coppery-green; and, moreover, the antennæ, instead of being ferruginous, are black.

Rare. In my collection.

5. *Callichroma chrysogramma*, Chevr. Rev. et Mag. d. Zool. 1855, p. 514.

Viridi-auratum; capite (longitudine) et thorace (latitudine) plicatis; scutello elytrisque (obscure rugose punctatis) vittis duabus obliquis viridi-aureis; thorace infra, pectore abdomineque virentibus, albido-sericeis.

Long. 7½ lin., lat. 1½ lin.

Of the size and form of *C. vittatum*, Fab., and of a brilliant golden green. Head punctate, raised between the antennæ, longitudinally grooved and plicate, with curved wrinkles behind. Palpi short; maxillary obscure, labial red. Mandibles punctate, wrinkled, green, black at the apex. Eyes black. Antennæ red, with the first article obscure. Thorax as long as broad, of a beautiful golden green, with very regular transverse folds, which are curved behind the middle; smooth and irregularly punctate below the sides; depressed, strongly plicate, and constricted near the inferior margin in front; median angles obtuse; in the middle of the back is a longitudinal line marked by a depression. Scutellum triangular, moderate, golden, and punctate. Elytra obscure, rugosely punctate, each with a coppery line which proceeds from the exterior of the shoulder and goes to the extremity of the suture. Underside of the body of a pale green covered by a whitish silky pubescence. Legs entirely ferruginous.

Rare. None received by me. M. Chevrolat described it from specimens received by Mr. T. Gray of Glasgow.

6. *Callichroma episcopale*, Chevr. Rev. et Mag. d. Zool. 1856, p. 436.

Planiusculum, nigrum; capite violaceo- vel cæruleo-viridi; antennis carinatis pedibusque clavatis nigro-cyaneis; tibiis quatuor anticis tarsisque totis cinereis; thorace viridi, elongato, transversim rugato, lateribus posticis spinoso; elytris opacis, rugose punctatis, nigro-cyaneis, vitta lata communi postice attenuata et abbreviata virescente; corpore infra viridi, lanugine alba induto.

Long. 8 lin., lat. 2 lin.

Flattened, narrow, and attenuated behind. Head of a fine violet or bluish green, abruptly truncate and raised between the antennæ, punctured in front, longitudinal channel narrow. Mandibles, palpi, labrum, clypeus, and eyes black. Antennæ slender, angular, flattened, grooved longitudinally, bluish black, velvety; first article club-shaped, strongly and rugosely punctate, with a spine or claw at the apex; second very small; third very long, suddenly swollen, and of a shining black at the apex;

fourth and fifth a little longer, and terminating in an angle; the rest simple. Thorax subcylindrical, elongated, of a deep brilliant green, covered with entire transverse wrinkles, furnished with two small tubercles behind near the base and near a small longitudinal ridge; lateral spine situated a very little behind the middle. Scutellum triangular, depressed, of a deep blackish green, marked by a small lateral stria. Elytra flat, as broad as the thorax at its widest, rounded on the shoulder (with a strong depression inside of it) and at the apex, marked by an abbreviated longitudinal middle nervure and by a broad green sutural stripe, which begins behind the scutellum and gradually diminishes in breadth until it disappears about a fifth or fourth from the extremity. Legs black, changing into blue according to position; thighs moderately abruptly swollen; anterior tibiæ and all the tarsi clothed with a silvery-grey pubescence.

This belongs to a different and more parallel and elongate type than the preceding species.

In my collection. Apparently rare.

7. *Callichroma cinereipes.*

Litopus cinereipes, Chevr. Rev. et Mag. d. Zool. 1856, p. 437.

Minutissime coriaceum, supra viridi-cyaneum, infra viridi-splendens; mandibulis, oculis, antennis pedibusque aterrimis; tarsis posticis cinereis; thorace lateribus angulose producto et supra depresso, antice constricto posticeque arcte tricostato.

Long. 11 lin., lat. 5 lin.

This belongs to a different type from *C. afrum*, *C. calcaratum*, &c. It is very like *Cerambyx cæruleus*, Oliv. Finely rugulose, green mixed with blue above, and a fine brilliant green below. Head raised and longitudinally grooved between the antennæ, rugosely punctate, green, blue on the sides, tri-emarginate in front. Parts of the mouth orange. Labial palpi black. Mandibles punctate, conical, that on the left most projecting, green at the base, black, smooth, and recurved at the apex. Labrum transverse, feebly depressed and emarginate. Clypeus almost straight. Eyes black. Antennæ ebony-black, third article twice the length of the fourth. Thorax rounded, unequal, angular near the anterior margin, compressed near the head, and the base with three transverse contiguous raised ridges, a strong dorsal depression on each side, between which is a green cruciform line, which is punctate. Lateral tubercles thick and obtuse, almost glabrous, and with scarcely any punctation. Scutellum triangular, depressed

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and punctate. Elytra of the breadth of the thorax, rounded on the shoulder (a small longitudinal depression within), and more narrowly at the apex, smooth, green and more brilliant at the apex, with the suture bluish and depressed in the middle at its posterior part. Legs smooth, of an ebony-black; the four anterior thighs abruptly swollen, posterior elongated and club-shaped; posterior tibiæ long, flattened. Tarsi blackish, grey below, posterior clothed with a silvery ashy pubescence.

I have only seen one specimen, which is in my collection.

M. Chevrolat described this as a *Litopus*; but the characters of that genus, as exposed by Prof. Lacordaire (Genera des Coleoptères, ix. p. 23), forbid its being ranked with it. It properly belongs to the genus *Callichroma*: for example, one of the characters of *Litopus* is to have the thorax rounded on the sides, and without spine or tubercle, while in *Callichroma* it is tuberculate; and the thorax of this species has thick and obtuse lateral tubercles or spines. The other characters also agree with those of *Callichroma*, and I have therefore removed it to that genus.

LITOPUS, Serv.

Litopus glabricollis.

Facie simillimus *Callichromati episcopali*, sed thorace differt omnino. Planiusculus, niger vel nigro-cyanescens; capite nitido, supra viridi, subtus nigro; antennis carinatis omnino ut in *C. episcopali*, pedibusque clavatis, nigro-cyaneis; thorace subgloboso, supra planato, glabro, nigro-cyaneo, lateribus parum viridibus, lævissime sparsim acupunctato; elytris opacis, rugose punctatis, nigro-cyaneis, vitta lata communi postice attenuata et abbreviata virescente; corpore infra cupreo et cupreo-viridi, densissime punctato, lanugine brevissima parum albida induto.

Long. 12 lin., lat. 2–2½ lin.

Exceedingly like *Callichroma episcopale*; scarcely any difference can be noted in the antennæ, the parts of the mouth, the legs, and the elytra; but the head differs somewhat, and the thorax entirely. Flattened, narrow, and attenuated behind. Mouth, eyes, antennæ, upper side of thorax, and legs black or bluish black; head, sides of thorax and scutellum green. Elytra blue-black, with a sutural stripe of green, broad in front, gradually attenuated behind, and terminating before reaching the apex. Head irregularly impressed and punctate, with three foldings in the middle between the eyes, and other irregular folds and grooves. Thorax large, at its widest nearly as broad as the base of the elytra, subglobular, flattened

above, smooth, glabrous, faintly, finely, and distantly acupunctate, narrowed both in front and behind; the anterior margin sinuate, the posterior straight; a slight longitudinal fovea in front in the dorsal line, the basal narrowed parts with small plicæ on each side running outwards and backwards from the middle line; sides brilliant, almost impunctate, widest behind the middle. Scutellum triangular, hollowed, and terminating in a point. Elytra square at the base; shoulders rather prominent, with a hollow on their inner side, surface shagreened, blackish blue, running into green at the suture, the green becoming narrower behind, and disappearing before it reaches the apex; a faint trace of a line running longitudinally from the base, inside the shoulder, to the apex; each elytron somewhat acutely rounded at the apex. Underside coppery and coppery-green, opaque, and so finely and closely punctured as to appear shagreened, and with a very short whitish pubescence, only visible in some lights. Legs as in *Callichroma episcopale*.

Only one specimen; in my collection.

LITOMECES*, nov. genus vel subgenus.

Genus vel subgenus affinis *Promeci*, differt ab illo antennis tenuibus haud incrassatis versus apicem; capite et thorace valde elongato; elytris parallelis; femoribus elytrorum apice longioribus.

Litomeces splendidus.

Promeces splendidus, Chevr. in Thoms. Archives Entom. ii. 243, pl. xiv. fig. 2.

Linearis, parallelus; capite antice prolongato, aureo-cupreo; antennis nigris, corpore parum longioribus, articulis elongatis, secundo curto, ceteris fere æqualibus; thorace aureo-cupreo nitido, subcylindrico, antice parum attenuato, parum punctato; scutello subcordiformi, punctato, viridi; elytris thorace vix longioribus, humeris rotundatis, fere parallelis, versus apicem paululo dilatatis, læte viridibus versus suturam, nigro-viridibus ad latera; pedibus læte cyaneo-nigris.

Long. 8½–9 lin., lat. 2 lin.

According to M. Chevrolat, this beautiful species is very like the *Closteromerus imperialis* of White. It differs from the true *Promeces* by its more delicate form, as well as by the characters given above.

* Name compounded from *Litopus* and *Promeces*, of both of which it shares the characters.

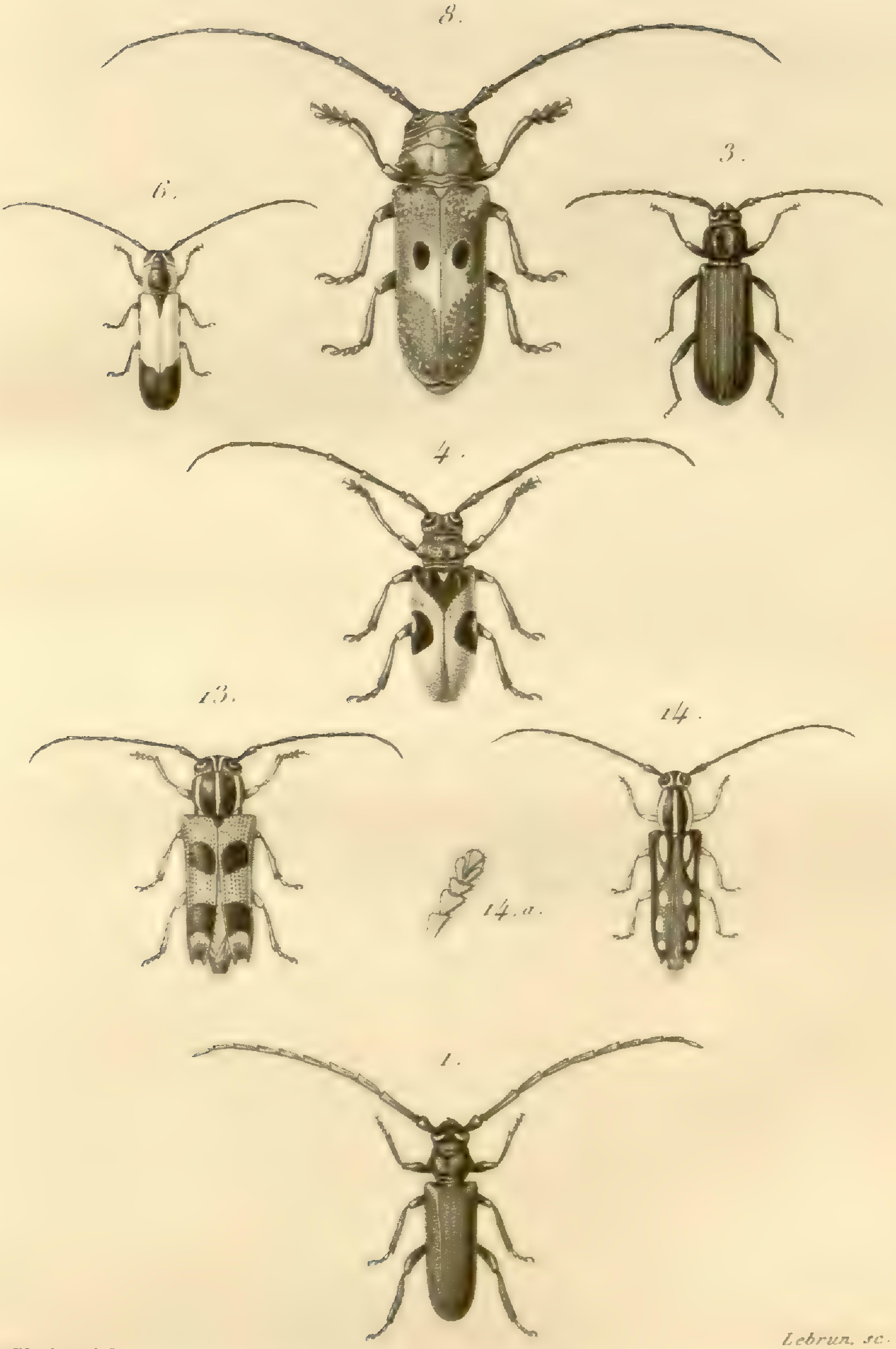
Head narrow, prolonged in front, of a brilliant glabrous golden copper-colour, sparsely punctate; it is keeled and grooved on its anterior margins, and a tolerably deep longitudinal channel extends to a little beyond the forehead. Palpi brownish black, pale at the apex of the articles. Mandibles black, wrinkled, punctate, sharp, smooth and curved at the extremity, tolerably dilated on the interior margin, and furnished with a tooth with an emargination near the base. Labrum transverse, narrow, black. Clypeus almost cut straight. Eyes rounded, emarginate above, black. Antennæ a little longer than the body, black, with elongate articles almost equal (with the exception of the second, which is short). The first is thick, rugosely punctate; its base has a transverse notch, and its apex is feebly angular. Thorax of a very brilliant golden copper, subcylindric, straight both in front and behind, more slender and attenuated near the anterior edge, wrinkled on the base, with small and distant punctures. Scutellum subcordiform, punctate, brilliant green. Elytra very closely punctate, and, as it were, shagreened, scarcely broader than the thorax, rounded on the shoulder, a little dilated towards the apex, which is rounded; they are of a fine green on the inner half, and a blackish green on the outer half. Breast and abdomen of a more delicate green; the segments, which are five in number, have their posterior margin blue. Legs of a fine indigo-blue; the four anterior thighs are suddenly swollen, the posterior are longer, passing beyond the elytra, and gradually thickened without becoming very strong; the apex of the four anterior tibiæ, as well as the first pair of tarsi, has an ash-coloured pubescence, and the remainder are fringed with that colour.

I have not received this. M. Chevrolat describes it from the collection of the late General Feisthamel. It is now in the British Museum (Chevrolat's collection).

Cordylomera, Serv.

1. *Cordylomera gratiosa*, Dej. Cat. 3rd ed. p. 353.

Parallela, linearis; mandibulis, oculis, antennis, scutello, tibiis, tarsis, geniculis et clava femorum posticorum nigris; palpis, labro et clypeo ferrugineis; femoribus anticis et mediis atque pedunculo posticorum rubris; capite nigro virescente, thorace supra chalceo; elytris dorso cupreo-viridibus, lateribus late et sutura tenuiter cæruleo-viridibus; corpore subtus saturate brunneo; capite parum punctato, antice fortiter impresso; antennis longitudine corporis parum longioribus, primo articulo clavato, secundo parvo, 3–7 lateri



Wapler, del. *Lebrun, sc.*

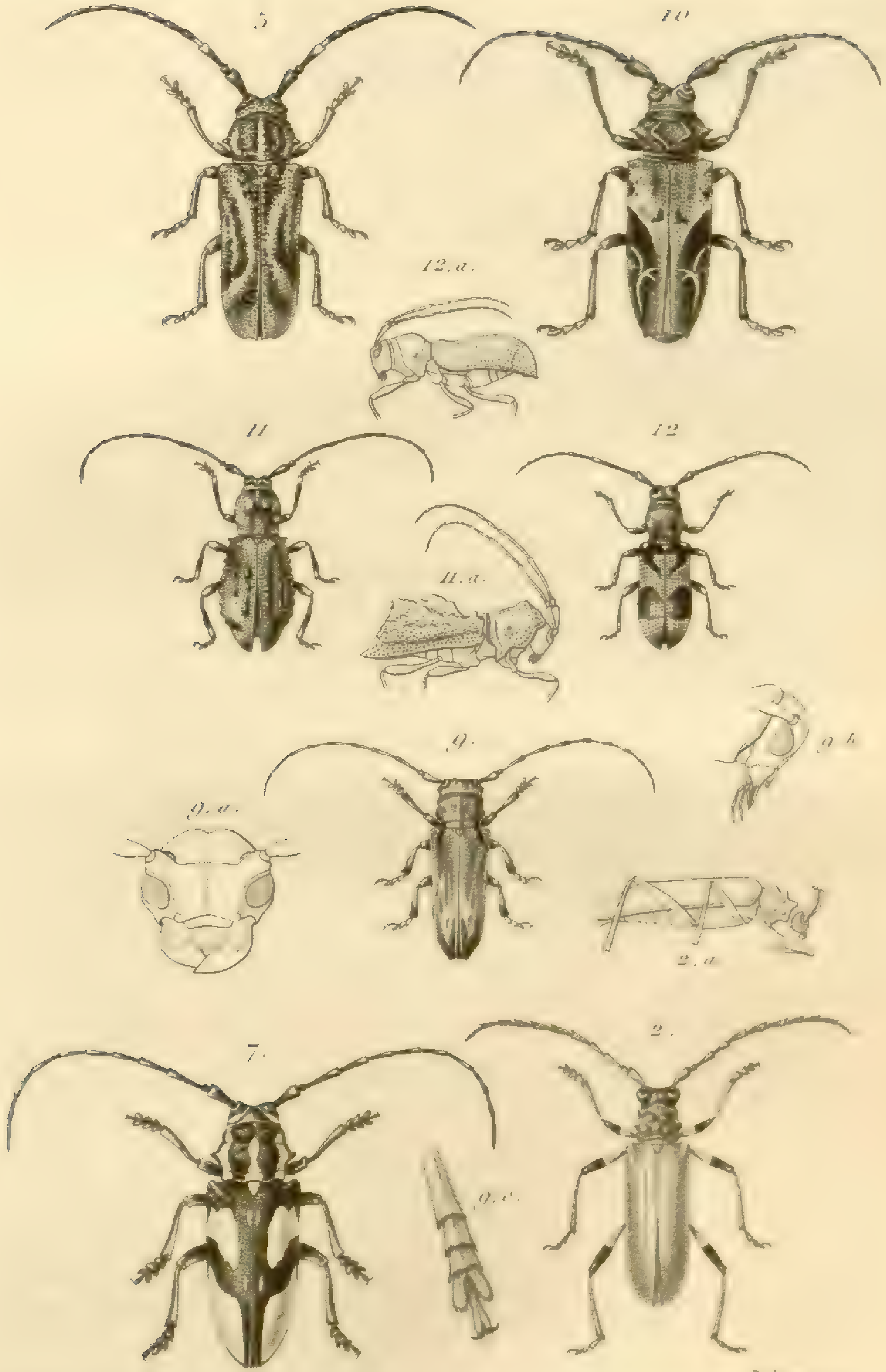
6 Tragocephala *Galathea*. 8. Prosopocera *myops*. 3. Smodicum *ebeninum*

4. Monohammus *Thomsoni*

13. Glenea *quinquelineata*. 14. Glenea *carneipes*.

1. Œme *nigrita*.

N. Rémond impr. R. Vielle-Estrapade, 15. Paris.



Wapler. del. *Lebrun. sc.*

5 Pachystola *annulicornis*. 10 Temnoscelis *Waddelii*.

11 Apomempsis *bufo* 12 Velleda *callizona*.

9 Tecton *quadrisignatum*.

7 Geloharpya *Murrayi*. 2 Allogaster *annulipes*.

N. Rémond impr. R. Vieille Estrapade, 15. Paris.

interno apice spinosis, 8–11 haud spinosis, sed latere externo angulatis; thorace subcylindrico, nitido, paulo pone marginem anteriorem constricto et illic lævi et vix punctulato, medio latiore, impresso, sat fortiter utrinque punctato, ad basin constricto et transversim rugato; scutello postice foveato; elytris parallelis, dorso planis, apice dentatis, punctatis; femoribus fortiter abrupte clavatis; tibiis et tarsis pube argenteo-cinerea vestitis.

Long. 6 lin., lat. $1\frac{1}{4}$ lin.

Parallel, linear. Mandibles, eyes, antennæ, scutellum, tibiæ, tarsi, knees, and club of the posterior thighs black; palpi, labrum, and clypeus ferruginous; anterior and middle thighs and peduncle of posterior thighs red; head black and virescent, greenest behind; thorax above brassy; elytra coppery green on the back and rich blue-green on the sides, apex, and suture, broadly on the sides, narrowly on the suture and apex; underside dark brown. Head finely punctate, more coarsely so in front behind the clypeus, deeply impressed by a transverse line drawn across from near the anterior angle of the eyes, with a transverse ridge between the antennæ, and with a hollow and a faint longitudinal line there; the hollow behind this ridge is punctate and transversely wrinkled. Antennæ a little longer than the body, with the first article not pubescent, rather thick and clavate, and finely punctate, the rest clothed with fine silvery cinereous pubescence; the second article small, the next five moderate and nearly equal in length, except the fourth, which is shortest, thickened at the apex, and each with a sharp spine at the inner angle of its apex, the first spine being the largest and the remainder gradually diminishing in size, until in the seventh article it is scarcely perceptible; the next three articles without spines on the inner side, but flattened and with an angle on the outer side, the last article emarginate at the apex on the outer side. Thorax subcylindrical, shining, narrowed a little behind the front and at the base, widest in the middle, bulging out so as to look slightly nodose, the narrow part in front smooth and very slightly punctate, that at the base transversely wrinkled, the intermediate part rather thickly, distinctly, and irregularly punctate, with a depression on each side of the disk and another longitudinal one on the sides, and a smooth, shining, clear space in the dorsal line. Scutellum impunctate, hollowed out in the back part. Elytra flattened, parallel, linear, square at the base, with the shoulders prominent, and a hollow on the inner side of them reaching nearly to the base of the scutellum, opaque, except at the base, which is shining, covered with not very close, scattered punctures, the apex terminating

in an incurved tooth or spine. Underside opaque, with a dull concolorous velvet pile. Thighs with the club large and abrupt; tibiæ and tarsi clothed with a fine cinereous pubescence.

Found both at Old Calabar and other parts of the west coast.

2. *Cordylomera ruficornis*, Chevr. Rev. et Mag. d. Zool. 1855, p. 283.

Affinis *C. spinicorni*, Fab. (*torridum*, Oliv.), sed minor, mediocriter et sat crebre punctata, viridis; antennis, thorace infra, pectore pedibusque rufis; thorace antice posticeque constricto; elytris singulatim in sutura aculeatis.

Long. $7\frac{1}{2}$ lin., lat. $1\frac{3}{4}$ lin.

This is very near the preceding species (*C. gratiosa* of Dejean), but differs from it by its antennæ, which, instead of being black, are red. The elytra are more flattened, the thighs more suddenly swollen, and the green colour above is more tender.

In the British Museum (Chevrolat's collection).

3. *Cordylomera suturalis*, Thomson, Archiv. Ent. ii. p. 155 (1858); Chevr. Archiv. Ent. ii. p. 242, pl. 14. fig. 3.

Præcedenti valde affinis; capite, antennis, thorace et scutello nigris; thorace bituberculato; elytris singulatim apice aculeatis; pedibus nigris; tibiis anticis et tarsis pube cinerea vestitis; subtus pube plumbeo-argentea vestitus.

Long. 9–10 lin., lat. 2 lin.

Distinguished from *C. spinicornis* and *C. ruficornis* by its black legs, its white silky underside, &c.

[To be continued.]

IV.—*Description of a Labyrinthodont Amphibian, a new Generic Form, obtained in the Coal-shale at Newsham, near Newcastle-upon-Tyne.* By Albany Hancock, F.L.S., and Thomas Atthey.

[Plate I.]

The fossil Vertebrata of the Coal-shale overlying the High-main seam at Newsham do not yet appear to be exhausted, notwithstanding the great attention that has been bestowed upon the subject, for many years past, by one of the authors of this paper.

In proof of this we have to record the recent occurrence, in the above locality, of two specimens of a small Labyrinthodont

skull, differing from any thing with which we are acquainted, and of such a peculiar character that it is necessary to establish a new genus for the reception of this curious species, which we propose to name *Batrachiderpeton lineatum.* One of the specimens is in a good state of preservation, and is almost entire. The anterior portion of it, however, is crushed and otherwise injured; but the characters of the hinder part are well displayed, and so are those of the median coronal bones, the surface-structure of the whole being beautifully preserved. The other specimen has lost a considerable portion of the right side, and is much crushed and distorted, but nevertheless exhibits, in excellent order, some of the more important characters.

The first-mentioned and the more perfect of the two specimens is flat and shield-like, having the contour in front pointed and broadly wedge-shaped, the sides of this part being broken; the occipital region is exceedingly wide, and considerably arched inwards at the posterior margin. It is evident, however, that, when perfect, the front was broad and rounded, the muzzle being quite short, and that the sides were arched outwards. The skull is remarkable for its great width in proportion to its length, and for the wing-like character of the lateral expansions of the occipital region, which are very largely developed and project considerably backwards, the lateral posterior angles being produced into long processes or cornua: consequently, from this peculiar formation the inward arching of the occipital margin arises. From the outer angles of the occipital bones there are two other or inner horns, which are much less than the outer pair. When entire, the skull must have had the form of a broad inverted shield, with the apex in front rounded, and the basal or posterior margin concave. It measures two inches and three tenths in length from the muzzle (the extremity of which is present) to a line extending from tip to tip of the external horns, but only an inch and seven eighths to the extremity of the inner or occipital cornua. One side of the skull, behind, is quite perfect; so, by doubling the width of this from the median line, the breadth of the entire skull can be correctly determined: measured thus, it is two inches and five eighths across the widest part; it is two inches and a quarter in width without making such allowance.

The central coronal bones are narrow in proportion to the great breadth of the entire skull, and their boundaries are marked by strongly raised lines or ridges. The occipitals in combination are quadrilateral, and are half an inch wide and six tenths of an inch long; behind, the margin is slightly concave, and from the sides, as if in continuation of the raised lateral

lines, the two inner cornua project; they are a quarter of an inch long, are conical and irregularly three- or four-sided, with the surface roughened with ornamentation like that of the skull.

In front the occipitals are divided from the parietals by a double, raised, transverse line. The latter are as wide as the occipitals, and have their lateral boundaries marked in the same manner by raised lines, which are in continuation of those of the occipitals, but are not so much elevated. These parietal lines slightly incline towards each other as they advance forward, which they do for about half an inch; they then diverge a little, and are lost in front in a circular groove which reaches four tenths of an inch further forward. The anterior boundary of the parietals appears to be at the point where the lateral lines are most approximate; and in front of this the circular groove may perhaps circumscribe the frontals and nasals.

On the longitudinal middle line, a little in advance of the posterior margin of the parietals, there is a circular foramen a tenth of an inch wide, thus proving that we are correct in denominating this elongated area the parietals: consequently the area behind must be that of the occipitals. But we must remark that the forward position of the parietals and the great extent of the occipitals are uncommon features in the Labyrinthodonts, and seem to indicate an approximation to the Batrachian form of structure—though, as we shall afterwards endeavour to show, our new genus is more closely related to the recent genera *Siren*, *Proteus*, and *Axolotl*.

It is difficult to say of what bones the lateral expansions are composed; they remind us much of similar expansions seen in other Labyrinthodonts, only they are proportionally much larger than usual. Judging from this similarity, it may be assumed that they are composed of the quadrates and squamosals, postorbitals and malars, so far as the posterior portions of them are concerned—though probably they also comprise the epiotics; for it can scarcely be supposed that these latter bones lie within the raised boundary lines which we assume to be those of the occipitals. And yet, from analogy, it might be thought that the inner cornua formed the posterior extremities of the epiotics. In front of the lateral expansions, and external to the frontals and parietals, the ridges on the surface probably indicate the presence of the several component bones of these parts; but it is impossible to determine with precision their limits and exact configuration.

The posterior margin of each lateral expansion extends in a straight line outwards and backwards from the base of the

occipital horn for seven tenths of an inch to the external horn, which projects backwards with a slight inclination outwards, and is four tenths of an inch long and one fourth of an inch wide at the base; the surface is rough, like that of the inner horns, and is carinated longitudinally above and below, so that it presents four irregular facets. Of the lateral margins only the posterior portion of the left side is perfect, and this turns suddenly forward from the base of the horn in a slightly convex line for nine tenths of an inch; it then bends rather abruptly forwards and inwards, and extends in an outward curved line for six tenths of an inch further, at which point the margin of this side is broken away in an inward-sloping direction to the anterior extremity of the skull. At the right side in front the lateral margin is folded inwards, and is otherwise injured for nearly two thirds of its length; the posterior third is almost perfect, but the lateral horn is broken off.

The surface of the skull is in a very good state of preservation, and is sculptured in a very peculiar manner, long linear ridges being the most conspicuous feature. As already stated, such ridges define the boundaries of the coronal bones; those of the occiput are very strong, and, together with the lateral ridges of the parietals, form along the sides of the central portion of the skull two nearly parallel lines enclosing the occipitals and parietals, each of which is rectangular in form. Other lines pass diagonally backwards in a radiating manner from the junction of the parietals and occipitals (that is, from the point where the transverse double line divides these two sets of bones), and are continued to the base of the outer horns; there are three or four of such lines on each side. Also from the base of the outer horns other three or four somewhat interrupted lines stretch diagonally forwards and inwards, extending nearly as far as the front of the parietals. At the posterior margin of the lateral expansions, and parallel to it, there are likewise two or three obscure lines.

Besides these lines, the occipital area and lateral expansions are irregularly tuberculated; in front the skull is comparatively smooth; but the whole surface, including the ridges and tubercles as well as the smooth portions, is covered with a minute reticulation of raised ridges; the meshes, being deeply sunk, give, when seen under a lens, a punctured appearance, and when so magnified this minute reticulation much resembles the usual Labyrinthodont honeycomb-like surface-structure.

The under surface of the specimen displays the roof of the mouth, which, though imperfect, exhibits some very interesting characters. In front the remains of the præmaxillæ

are seen at either side doubled inwards and pressed down; they seem to have been short, probably not much over six tenths of an inch in length. That of the right side is nearly entire, and lies with its outer surface exposed, which is covered with a minute reticulation of raised lines. The posterior extremity is considerably produced beyond the teeth, and is pointed and conical. This process is apparently for cartilaginous attachment. The alveolar border is straight and thick, and contains seven teeth, three or four of which are perfect; they are close-set, stout, and slightly incurved, with the tips rather abruptly pointed, a little compressed in the direction of the length of the jaw, and finely and sharply striated, the striæ being raised; the base and middle portion are smooth and cylindrical. A mere trace of the left præmaxilla is visible; but four or five of its teeth are pressed down upon the vomer. These teeth are well preserved, and have all the characters of those of the right side.

The vomer is largely developed, and extends backward quite half the length of the skull; it is divided by a suture on the longitudinal middle line, and the two lateral portions diverge a little behind. To these diverging points the pterygoids are attached; they are wide, stout bones, which, passing outward and backward, abut at the posterior portion of the malars or the bones forming the hinder lateral margins of the skull. In front of the pterygoids there is a large depression on each side, which may be the palato-temporal foramen: these depressions are circular in front; but their inner posterior boundaries are formed by the almost straight line of the pterygoids.

On the middle longitudinal line behind the pterygoids there is an elevated process, which probably indicates the presence of the sphenoid; and behind this, on either hand, at the posterior margin of the skull, which is bounded by a strong ridge, there is a rounded elevation. These two elevations are probably the occipital condyles, pressed inwards; or it may be that they are the lateral margins of the sphenoid turned upwards and distorted.

The large plates in front, which we have assumed to be the vomers, may possibly hold in combination the palatal bones. Be this, however, as it may, they are thickly covered with minute teeth from end to end, and to within a short distance of the lateral margins. These teeth do not appear to be arranged in any particular order, but are much obscured by the matrix. A few, however, are quite free, and show that they are short, stout, pointed, conical, and have the apices striated. This great patch of minute teeth is bounded on

either side by a row of eight or ten stout close-set teeth, similar in all respects to the præmaxillary teeth, even to the apical compression and striation; and they are nearly as large, if not quite as large, as they are. The posterior one, which is placed close in front of the palato-temporal foramen, is larger than the rest, and is certainly equal in size to the præmaxillary teeth.

The other or less perfect specimen of the skull has lost the whole of the right side; and the margin of the left side is much injured, and is doubled inwards. It is quite evident, however, that this specimen, when perfect, was quite as large as the one first described; and the surface-ornamentation is of the same character. The two principal coronal bones, the occipitals, and parietals are almost entire, and are of the same rectangular form. The parietal foramen is distinctly displayed, and in every respect agrees with that of the other example. The left outer horn is present, and shows no variation in character; the two inner horns and the right outer horn are broken away.

The left præmaxillary bone is pressed inwards, and agrees in size and position with that previously described. It has seven teeth, beautifully preserved, the exact number in the other specimen; and, in fact, the præmaxillaries of the two individuals are in every respect similar; only in that now before us the posterior pointed extremity is apparently hidden in the matrix. The greater portion of the vomer is preserved, and is studded, in the same manner as in the first specimen, with numerous, short, stout, conical teeth. The left outer or lateral row of vomerine teeth are well exhibited, and are pressed down inwards; they are ten or twelve in number, and are quite as large as those of the præmaxillary, and are in like manner striated at the apices. They seem better developed and are rather more numerous than in the other specimen; but in it these teeth are broken down and are much encumbered with the matrix, and there can be little doubt some of them have entirely disappeared; eight nevertheless can be counted. Had we not had the first-described specimen for comparison, we might have taken this lateral row of vomerine teeth to have belonged to either a maxilla or a mandible pressed inwards; but after carefully considering the evidence for and against, we think it favours the opinion we have adopted, though it is quite possible that we may be mistaken. At the same time it must be remarked that this row of teeth occupies exactly the same position that the lateral vomerine row does in the other specimen, that it is of the same length, and that the number of teeth is apparently the same, two or three having been removed in the first specimen.

The folded margin of the cranium exhibits in front a longitudinal depression, which there can be little doubt indicates the position of the orbit; indeed at one point the inner orbital margin can be traced. A similar depression is observable in the other specimen, at the right side. The only other feature worthy of notice in our second specimen is the pterygoid; that on the left side is pretty well preserved, and shows no variation of character, except that the surface is minutely striated in a longitudinal direction.

For three or four years past, Mr. Atthey has had in his possession a mandible belonging to this new Labyrinthodont; and, though always believing it to be distinct from that of any known species, we have kept it back till now, not feeling ourselves justified in encumbering the nomenclature with terms signifying so little and, in a scientific point of view, almost valueless. We are now, however, in a position to associate it with a cranium possessing important and interesting features. There can be no doubt that this mandible is really that of *Batrachiderpeton*. The surface-character of the bone, its size, and the character, form, and size of the teeth all go to prove this.

This mandible is perfect in front, where it is obtusely pointed; behind it is imperfect, a considerable portion evidently having been removed. The outer surface is exposed, and is seen to be covered with a few coarse, irregular, longitudinal ridges, having much the character of those on the cranium; and in front there are a few reticulated ridges, quite similar to those on the præmaxillæ. It is an inch long and a quarter of an inch broad at the widest part; the margins are nearly parallel, the jaw narrowing only very slightly forwards; the alveolar border is thick and almost straight, there being a slight depression near the centre, dividing the teeth into two groups. In all, there are fifteen teeth; they are closely arranged, stout, a little incurved, rather obtusely pointed, and have the tips finely striated and slightly compressed in the direction of the length of the jaw—agreeing in these peculiarities, as in all the other characters, with the præmaxillary teeth. They are confined to the anterior portion of the mandible, there apparently having been none in the posterior part. The range of the teeth will therefore correspond very well to those of the præmaxilla. They are the sixteenth of an inch in length, being of the same size as those of the præmaxilla.

It is impossible to contemplate the structure of the roof of the mouth of this curious Labyrinthodont without being reminded of the arrangement of the parts in that of *Siren*, *Proteus*, and *Axolotl*. The well-armed vomer in particular is

very striking. The extensive development of this vomerine armature, and the deficiency of bony maxillæ, would seem to ally *Batrachiderpeton* to *Siren* and *Proteus*; while the relationship of the vomers to the pterygoids, and the form of the latter, are very similar to what obtains in *Axolotl*. And the alliance with this interesting form would be rendered still stronger if it should turn out that our new genus has really bony maxillæ, particularly as the præmaxillæ are armed with teeth. In *Siren* and *Proteus* the præmaxillaries are quite minute, and are devoid of teeth.

The characters of the præmaxillæ in *Batrachiderpeton* are, as we have seen, only imperfectly displayed, and some doubt as to their form and extent might be entertained. But it would seem likely that in them we see the whole of the bones of the upper jaw, and that they must have stretched outwards and backwards, and have each been united to a membrane or cartilage (the representative of the maxilla), and in this way have become attached to the under surface of the malar or the lateral cranial bone where it is smooth and seems well fitted for such attachment; they could not have been attached to the outer edge of it, for it is covered with surface-ornamentation. By this arrangement spaces for the orbits are provided; and thus, again, our new Labyrinthodont would seem to resemble *Siren* and *Proteus*.

That this is the fact is apparently corroborated by what can be traced of the bones themselves. The præmaxilla of the right side in the more perfect specimen is, as before pointed out, pressed inwards upon the vomer, or rather in front of it. Before, it is wide, and is continuous with the bone of the muzzle, as is proved by the continuation of the surface-ornament. Behind, however, it appears to have been free, and to have terminated in a pointed extremity. On this side, too, the malar is turned inwards; but its anterior extremity, which is pointed, does not seem to be united to the præmaxilla; it has likewise all the appearance of having been free.

In the less perfect specimen, as before mentioned, the præmaxilla of the left side is pressed inwards in the same manner as that of the right side in the other specimen; and both agree in having seven teeth, and in having had apparently the posterior extremity free. From these coincidences it would seem fair to assume that the præmaxillæ comprise the whole of the bony structure of the upper jaw. At the same time it must be allowed that, as previously pointed out, the row of teeth on the left side of the vomer in one of the specimens has much the appearance of having belonged to a maxilla; and if this should prove to be the case, then *Batrachiderpeton* would be more closely allied to *Axolotl* than to *Siren*.

In the large size of the coronal bones, *Batrachiderpeton* also shows an alliance with *Siren* and *Axolotl*, while, in the squareness of the occipitals and parietals it agrees with the Salamander and the Batrachians. But, notwithstanding these deviations from the usual characters, there can be little doubt that our new form is a true Labyrinthodont; for the lateral cranial expansions, though more developed than commonly, are very similar to those characteristic features of these amphibians. And the parietal foramen is most significant, as well as the stoutness of the teeth; and the row of strong vomerine teeth on each side is also characteristic.

But this is not the only instance in which a Labyrinthodont has been found to exhibit an approximation to the *Siren*-type of structure. *Pteroplax* is so related, as we have pointed out in the May Number of the 'Annals.' At present, however, it is not necessary to dilate further on this matter than to state that *Pteroplax* seems to approach *Siren* in a different line from that by which it is approximated by *Batrachiderpeton*. In the former the lateral cranial expansions of the Labyrinthodont are entirely reduced, while in the latter they are even exaggerated in extent; and in *Pteroplax*, again, the coronal bones are not much altered in form, and the frontals are very long, showing that the muzzle was much produced. In *Batrachiderpeton*, on the contrary, the muzzle is extremely short, and the posterior region of the skull is much developed. *Pteroplax* shows its relationship to *Siren* by the reduction of the lateral cranial expansions, *Batrachiderpeton* by the large development of the occipital and parietal bones, both also by the peculiar character of the præmaxillæ and the deficiency of bony maxillæ, though, as we have already seen, there may be some doubt as to this last feature in *Batrachiderpeton*.

EXPLANATION OF PLATE I.

Fig. 1. Dorsal view of the cranium of *Batrachiderpeton lineatum*, a little enlarged; the dotted lines indicate the restored parts: *a*, occipital bones, bounded by raised lines; *b*, inner cornua; *c*, parietals exhibiting foramen near the posterior part; *d*, area circumscribed by a circular groove, probably the frontals and nasals; *e*, lateral expansion; *f*, one of the outer cornua; *g*, supposed malar; *h*, præmaxillæ, indicated in outline, in their supposed natural position; *i*, orbits, indicated by dotted lines.

Fig. 2. View of roof of mouth of the same: *a*, inner cornua; *b*, one of the outer cornua; *c*, left malar; *d*, right malar, bent inwards; *e*, right præmaxilla, doubled inwards; *f*, free posterior extremity of ditto; *g*, teeth of the left præmaxilla, bent inwards; *h*, vomer studded with minute teeth; *i i*, two lateral rows of large vomerine teeth; *j*, pterygoid; *k*, an eminence, probably the sphenoid; *l*, two elevations, perhaps portions of the sphenoid, or possibly

h
d
1
e
7
3
8
4

the occipital condyles; *m*, occipital ridge; *n*, palato-temporal foramen; *o*, a depression, probably marking the position of the right orbit.

Fig. 3. View of the anterior portion of the left mandible, exhibiting the teeth and surface-ornamentation: *a*, anterior extremity.

Fig. 4. Three præmaxillary teeth, seen in front, much enlarged.

Fig. 5. Side view of one præmaxillary tooth, much enlarged.

Fig. 6. Much enlarged view of the apical extremity of the same, exhibiting the striation.

Fig. 7. Two of the small vomerine teeth, considerably enlarged.

V.—*Mediterranean Mollusca.* By J. Gwyn Jeffreys, F.R.S.

Although the coasts of the Mediterranean have been diligently explored by many naturalists during the last half-century, the Mollusca from deeper water are not sufficiently known. With the exception of Forbes's dredgings in the Ægean, which reached the extreme limit of 230 fathoms, and of the accidental discovery of abyssal life by means of the electric telegraph-cable taken up between Cagliari and Bona at a depth of from about 1100 to between 1500 and 1600 fathoms, I am not aware that any systematic investigation of the Mediterranean bed beyond fifty fathoms has ever been made or even attempted. Of course, I do not forget the dredgings carried on for two years by Mr. M'Andrew in different parts of the Mediterranean, and which have been of the greatest service to all who are interested in the geographical distribution of the Mollusca; but these dredgings, as recorded, did not exceed the depth of fifty fathoms. For the same reason I will not specially refer to the dredgings of Admiral Acton, the Marquis de Monterosato, Herr Weinkauff, Mr. Hanley, Professor Capellini, the Marquis James Doria, M. Susini, Dr. Manzoni, myself, and others on the coasts of Naples, Sicily, Algeria, Nice, Spezzia, Corsica, Elba, and Piedmont.

The kindness of my friend Capt. Spratt, R.N., F.R.S. (who is so well known to the scientific world, not only in connexion with Forbes's Ægean exploration, but as the author of an admirable work on Crete), and of Capt. Nares, R.N. (the commander of H.M.S. Newport), enables me to offer the present small contribution towards our knowledge of the Mediterranean Mollusca. The dredgings of Capt. Spratt were made in 1845 and 1846, those of Capt. Nares in 1868 and 1869. The former may be thus stated:—Sea of Marmora, 20 fathoms; east coast of Eubœa, 100 f.; Hydra Channel, 130 f.; off the south end of Hydra, 250 f.; and forty miles

east of Malta, 310 f. The latter are:—Pantellaria, 40 f.; South Syracuse, 40 f.; the Adventure Bank, between Sicily and Tunis, 60 f.; Tunis Bay, 30 f.; and off that coast, 50 to 100 f. These will be distinguished by the following abbreviations:—"Marm." for the Sea of Marmora; "Æg." for the Ægean, comprising Eubœa and the Hydra coast; and "Med." for the other places.

I will again refer to the Porcupine Expedition (see the last Number of the 'Annals,' p. 439) whenever any of the species occurred in it.

Not the least interesting result from all these Mediterranean dredgings consists in the discovery in a living or recent state of several species which had previously been known as fossil only, and were considered extinct. More extended investigations and gradual experience confirm my opinion, published eight years ago*, that probably all the Mollusca which lived during the periods represented by our newer Tertiary strata still survive in some part or other of the European seas.

With regard to not only the subject of this communication, but also to the Norwegian Mollusca mentioned in the last Number, Mr. J. T. Marshall has most obligingly and skilfully assisted me by examining the produce of the various dredgings. A quick eye and great patience are indispensable for such work. My best thanks are likewise due to Herr Weinkauff and Professor Allman for sending me typical specimens of some of Forbes's Ægean species. Unfortunately his descriptions, or rather diagnoses, are insufficient to identify many of these species; and his types were dispersed among public and private collections. Another inspection of my friend Mr. M'Andrew's Mediterranean shells has also been of considerable use to me.

Dr. Carpenter will do full justice to the Foraminifera, and Mr. Robertson to the Ostracode Crustacea which were procured in the dredgings of Capt. Spratt and Capt. Nares.

Brachiopoda.

Terebratula vitrea, Gmelin. Philippi, En. Moll. Sic. i. 95, t. 6. f. 6, and ii. 66. Med. 50–310 fathoms; var. *minor*, Med. 40 f. The inner layer of a valve from the greatest of these depths is traversed in every direction by the same kind of branching organism which has puzzled so many microscopists. See 'British Conchology,' i. Intr. lxii, and iii. 363.

* British Conchology, i. Introd. p. xci.

Argiope decollata, Chemnitz. B. C. ii. 18, and v. 164, pl. 19. f. 3. Med. 40–100 f.; Æg. 130 f.

A. cuneata, Risso. Ph. i. 96, t. 6. f. 13, and ii. 69 (*Orthis pera*); and var. *albicolor*. Med. 40 f. Several specimens occurred, all the Brachiopods being gregarious. *Terebratula scobinata*, Cantraine.

A. lunifera, Ph. B. C. ii. 19 (*A. cistellula*), and v. 164, pl. 19. f. 4. Æg. 100–130 f.

A. neapolitana, Scacchi. Ph. i. 97, t. 6. f. 15, and ii. 69; B. C. ii. 22. Med. 40–100 f.

Megerlia truncata, Linné. Ph. i. 95, t. 6. f. 12, and ii. 69; B. C. ii. 22. Med. 40–100 f.; Æg. 100 f. The habitat given by Linné ("in pelago Norvegico") is erroneous, so far as we at present know.

Platydia Davidsoni, E. Deslongchamps, Ann. & Mag. N. H. ser. 2. xvi. 443, pl. 10. f. 20, 20 *a–d*. Æg. 100 f.

Thecidea mediterranea, Risso. Ph. i. 99, t. 6. f. 17, and ii. 70. Med. 50–100 f.

Crania anomala, Müller. B. C. ii. 24, and v. 165, pl. 19. f. 6 = *Anomia turbinata*, Poli. Med. 40–100 f.; Porcupine Expedition, 30–290 f.

Conchifera.

Anomia ephippium, L. B. C. ii. 30, and v. 165, pl. 20. f. 1; and var. *aculeata*. Med. 40–100 f.; Æg. 100 f.; P. 10–557 f.

A. patelliformis, L. B. C. ii. 34, and v. 165, pl. 20. f. 2. Med. 40 f.; P. 60–420 f.

Ostrea cochlear, Poli. Ph. i. 80, and ii. 63. Med. 40–100 f.; P. 96–110 f.; Mediterranean cable, 1100 f. (A. Milne-Edwards). This is the *O. spectrum* of Leathes's MS., from the Coralline Crag at Ramsholt, but not the variety *parasitica* of *O. edulis*, which is a wholly different form.

Spondylus gæderopus, L. Ph. i. 86, and ii. 62. Med. 40 f.; Æg. 100–130 f.

S. Gussoni, Costa. Ph. i. 87, t. 5. f. 16, and ii. 63. Med. 40 f.; Æg. 100 f.

Pecten pusio, L. B. C. ii. 51, and v. 166, pl. 22. f. 1. Med. 40–100 f.; P. 30–40 f.

P. varius, L. B. C. ii. 53, and v. 166, pl. 22. f. 2. Med. 40 f.; P. 10 f.

P. opercularis, L. B. C. ii. 59, and v. 166, pl. 22. f. 3. Med. 60–100 f.; Marm. 20 f.; P. 30–96 f.

P. septemradiatus, Müll. B. C. ii. 62, and v. 166, pl. 23. f. 1. Med. 50–100 f.; Æg. 130 f.; Marm. 20 f.; P. 90–664 f.

Pecten Testæ, Bivona. B. C. ii. 67, and v. 167, pl. 23. f. 3. Med. 50–100 f.; Æg. 130 f.; P. 30–164 f.; Mediterranean cable, 1100 f. (A. Milne-Edwards).

P. similis, Laskey. B. C. ii. 71, and v. 168, pl. 23. f. 5. Med. 40–100 f.; Æg. 130–250 f.; P. 40–420 f.

P. vitreus, Ch. B. C. v. 168, pl. 99. f. 6. Med. 310 f.; P. 208–664 f.

P. Philippi, Récluz, Journ. de Conch. iv. 52, t. 2. f. 15, 16 = *P. gibbus*, Ph. Med. 40–100 f.

Pleuronectia fenestrata, Forbes, British Association Report 1843, 192 (*Pecten*). B. C. v. 168. Med. 50–100 f.; Æg. 100–250 f.; P. 203–2435 f. The lower valve is *Pecten concentricus* of Forbes and *P. antiquatus* of Philippi.

Lima Sarsii, Lovén. B. C. ii. 78, and v. 169, pl. 25. f. 1 = *L. crassa*, Forb., ex typ. Med. 50–100 f.; Æg. 100–250 f.; P. 420–422 f.

L. elliptica, Jeffreys. B. C. ii. 81, and v. 169, pl. 25. f. 2. Med. 40 f.; P. 45–208 f.

L. subauriculata, Montagu. B. C. ii. 82, and v. 169, pl. 25. f. 3. Med. 40–310 f.; Æg. 130 f.; P. 125–1443 f.

L. Loscombii, G. B. Sowerby. B. C. ii. 85, and v. 170, pl. 25. f. 4. Med. 50–100 f.; P. 64–75 f.

L. squamosa, Lamarck. Ph. i. 77, and ii. 56. Med. 40 f.

Avicula hirundo, L. B. C. ii. 95, and v. 170, pl. 25. f. 6. Med. 50–100 f.

Mytilus phaseolinus, Ph. B. C. ii. 118, and v. 171, pl. 27. f. 5. Med. 40–100 f.; Æg. 130 f.; P. 30–110 f.

M. vitreus (Holböll), Möller, Ind. Moll. Grœnl. 19 (*Modiola*?) = *Dacrydium vitreum*, Torell, Spitzb. Moll. 19, t. 1. f. 2 *a*, *b*. Med. 50–100 f.; Sicily, 35 f. (Marquis T. Allery de Monterosato); Greenland (Möller and Torell); Spitzbergen (Torell); Finmark (M'Andrew and Sars); P. 164–2435 f. Fossil in the Arctic shell-clay, Fife (Rev. Thos. Brown). Living specimens from the Porcupine dredgings in very deep water (2090 and 2435 f.) were of a reddish-brown colour, and enclosed in a membranous case. The genus *Dacrydium* proposed by Prof. Torell for this species seems to be unnecessary; at least I cannot detect any characters to distinguish it generically from *Mytilus phaseolinus*. The name *Dacrydium* has been long used in botany.

Modiolaria marmorata, Forb. B. C. ii. 122, and v. 171, pl. 28. f. 1. Med. 40 f.; P. 15–80 f.

Crenella rhombea, Berkeley. B. C. ii. 131, and v. 172, pl. 28. f. 5.

Nucula sulcata, Bronn. B. C. ii. 141, and v. 172, pl. 29. f. 1. Med. 30–100 f.; Æg. 130 f.; Marm. 20 f.; P. 15–208 f.

Nucula nucleus, L. B. C. ii. 143, and v. 172, pl. 29. f. 2. Med. 40–100 f.; P. 10–1180 f.

N. tenuis, Mont. B. C. ii. 151, and v. 172, pl. 29. f. 4. Med. 60 f.; Æg. 130–250 f.; P. 15–183 f.

Leda pygmæa, Münster. B. C. ii. 154, and v. 173, pl. 29. f. 5. Med. 50–310 f.; Æg. 130 f.; P. 40–1180 f. A valve of this species from 310 fathoms is permeated by the same tubular organism as the above mentioned valve of *Terebratula vitrea*. Some extremely minute shells, which have the general appearance of young *L. pygmæa*, but are regularly oval and rounded at each end, without any slope from the beak, were in the dredgings from 310 fathoms. They may be the fry of *L. pellucida*, Ph. (a Calabrian and Sicilian fossil), although in that species the teeth are numerous and close-set, while in these shells they are very few and remote.

*Leda acuminata**, Jeffreys.

SHELL somewhat inequilateral, the posterior or narrower side being longer (in the proportion of between 6 and 7 to 5) than the other side, with a downward slope from the beak to each end; it is moderately convex, not very thin, semi-transparent, and glossy: *sculpture*, numerous fine concentric and close-set striæ, and an angular ridge from the beak to the longer side; the striæ are partially or wholly wanting in some specimens: *colour* pearl-white under the epidermis, which is pale yellowish-brown and shiny: *margins* rounded at the anterior side, and extended on the other or longer side to a wedge-like point, being as it were pinched up at that end; lower margin nearly semicircular: *beaks* very small, as well as the *cartilage* and pit: *teeth* from ten to twelve on each side, minute near the beaks and becoming spike-shaped towards the outer end, where they decrease in size: inside polished, with a smooth and sharp edge: *muscular scars* distinct. L. 0·1125, B. 0·175.

Med. 310 f.; P. 370–862 f. Hitherto known only as a Sicilian fossil, Professor Seguenza having kindly sent me specimens from the neighbourhood of Messina, as *L. messanensis*. As he has not described it, I venture to prefer the characteristic name which I had given to the species when I dredged it off the west coast of Ireland to the local name proposed by him.

L. commutata, Ph. i. 65 (*Nucula striata*), and ii. 46 (*N. minuta*). Med. 30–100 f.; Æg. 130 f.

L. pella, L. Ph. i. 64, and ii. 45 (*Nucula emarginata*). Med. 50–100 f.; Marm. 20 f.

* Pointed.

Pectunculus glycymeris, L. B. C. ii. 166, and v. 175, pl. 30. f. 2. Med. 40–100 f.; P. 60–80 f.

Arca pectunculoïdes, Sc. B. C. ii. 171, and v. 175, pl. 30. f. 3. Med. 40–100 f.; Æg. 100–250 f.; P. 66–422 f.

A. obliqua, Ph. B. C. ii. 175, and v. 175, pl. 30 f. 4. Med. 50–100 f.; Æg. 100–250 f.; P. 164–422 f.

A. lactea, L. B. C. ii. 177, and v. 175, pl. 30. f. 5. Med. 30–100 f.; Æg. 130 f.

A. nodulosa, Müll. B. C. ii. 180, and v. 176, pl. 100. f. 2. Æg. 100–250 f.; P. 155–363 f. It varies considerably in shape, some specimens having the dorsal margin more angular than in other specimens from the same locality.

A. imbricata, Poli. Ph. i. 58, and ii. 42; B. C. ii. 180. Med. 40–100 f.

A. barbata, L. Ph. i. 57, and ii. 42; B. C. ii. 183, and v. 176. Med. 40–100 f.

A. diluvii, Lam. Ph. i. 59, t. 5. f. 2 (*A. antiquata*), and ii. 43. Med. 30–100 f.; Marm. 20 f.

A. tetragona, Poli. B. C. ii. 180, and v. 176, pl. 30. f. 6. Med. 40–100 f.

A. Noæ, L. Ph. i. 56, and ii. 42; B. C. ii. 182. Med. 30–100 f.

Lepton nitidum, Turton. B. C. ii. 198, and v. 177, pl. 31. f. 3. Med. 50–100 f.; Æg. 130 f.

L. sulcatulum, Jeffr. B. C. ii. 201, and v. 177, pl. 31. f. 4. Med. 40–100 f.

Scacchia elliptica, Sc. Ph. i. 34, t. 4. f. 1 (*Lucina? oblonga*), and ii. 27, t. 14. f. 8. Med. 30 f.

Montacuta substriata, Mont. B. C. ii. 205, and v. 177, pl. 31. f. 6. Med. 40 f.; P. 73–420 f. The last depth indicates also the habitat of *Spatangus purpureus*, to which this mollusk is almost invariably attached.

M. bidentata, Mont. B. C. ii. 208, and v. 177, pl. 31. f. 8. Med. 30–100 f.; P. 3–1366 f.

Kellia? cycladia, S. Wood. B. C. ii. 228, and v. 179, pl. 32. f. 3. Med. 40 f.; Æg. 100 f.; P. 1366–1380 f.

Loripes divaricatus, L. B. C. ii. 235, and v. 179, pl. 32. f. 5. Med. 40 f.

Lucina spinifera, Mont. B. C. ii. 240, and v. 179, pl. 32. f. 6. Med. 40–100 f.; Marm. 20 f.; P. 45–50 f.

L. borealis, L. B. C. ii. 242, and v. 179, pl. 32. f. 7. Marm. 20 f.; P. 25–208 f.

L. reticulata, Poli. Ph. i. 31, t. 3. f. 14, and ii. 24 (*L. pecten*). Med. 40 f.

Woodia digitaria, L. Ph. i. 33, t. 3. f. 19, and ii. 25 (*Lucina digitalis*); B. C. ii. 238, 239, and v. 179, pl. 100. f. 6.

Med. 30–100 f. This species may also be the *Tellina pisiformis* of Linné, although its mention in the 'Fauna Suecica' and the habitat there given ("ad O. Europæi ostia fluviorum") are clearly erroneous.

Axinus transversus, Forbes, B. A. Rep. 1843, 192 (*Kellia*). Med. 310 f. Not *Lucina transversa* of Bronn, which is *A. flexuosa*, var. *Sarsii*.

A. ferruginosus, Forb. B. C. ii. 251, and v. 180, pl. 33. f. 3. Med. 50–100 f.; P. 40–557 f.

Diplodonta rotundata, Mont. B. C. ii. 254, and v. 180, pl. 33. f. 4. Med. 60 f.

D. trigonula, Bronn. Ph. i. 31, t. 4. f. 6, and ii. 24; and young (*D. apicalis*). Med. 40 f.; Æg. 100 f.

Cardium echinatum, L. B. C. ii. 270, and v. 181, pl. 34. f. 2. Marm. 20 f.; P. 15–114 f.

C. papillosum, Poli. B. C. ii. 275, and v. 181, pl. 35. f. 1. Med. 40–100 f.

C. exiguum, Gm. B. C. ii. 278, and v. 181, pl. 35. f. 2. Med. 40 f.; P. 3 f.

C. fasciatum, Mont. B. C. ii. 281, and v. 181, pl. 35. f. 3. Med. 50–100 f.; P. 30–75 f.

C. minimum, Ph. B. C. ii. 292, and v. 182, pl. 35. f. 6. Med. 30–100 f.; Æg. 130–250 f.; P. 15–542 f.

C. oblongum, Ch. Ph. i. 50, and ii. 37 (*C. sulcatum*). Med. 50–100 f.

Cardita corbis, Ph. i. 55, t. 4. f. 19, and ii. 41. Med. 40–100 f.

C. sulcata, Bruguière. Ph. i. 53, and ii. 40. Med. 40 f.

C. trapezia, L. Ph. i. 54, and ii. 41. Med. 40 f.

C. aculeata, Poli. Ph. i. 54, t. 4. f. 18, and ii. 41. Med. 40–100 f.; Æg. 100–130 f.

Chama gryphoïdes, L. Ph. i. 68, and ii. 49. Med. 50–100 f.

Isocardia cor, L. B. C. ii. 298, and v. 182, pl. 36. f. 1. Med. 50–310 f.; Æg. 100–250 f.; P. 106–1380 f. All but one of the Mediterranean and Ægean specimens were the fry, which I noticed in the last Number of the 'Annals.'

Astarte sulcata, Da Costa. B. C. ii. 311, and v. 183, pl. 37. f. 1; var. *incrassata*. Med. 40–100 f.; Æg. 130 f.; P. 15–420 f.

A. modesta, H. Adams, Proc. Zool. Soc. 1869, 275, pl. 19. f. 14 (*Gouldia*). Med. 50–100 f. Allied to *A. excurrens* of Searles Wood, and possibly the same species.

A. parva, S. Wood, Mon. Crag Moll. 192, pl. 17. f. 12, *a, b*. Med. 50–100 f. Hitherto known only as a Tertiary species. This may possibly be the *A. pusilla* of Forbes, because of the words "concentrice striata" in his descrip-

tion; but the present species (like the Crag fossil) has strong oblique ridges, and the shape is remarkably inequilateral. The inside margin is notched in my specimens.

Astarte bipartita, Ph. i. 32, t. 3. f. 21, and ii. 25 (*Lucina? bipartita*). Med. 40–100 f.

A. triangularis, Mont. B. C. ii. 318, and v. 183, pl. 37. f. 5. Med. 40–100 f.; Æg. 130 f.

Circe minima, Mont. B. C. ii. 322, and v. 183, pl. 37. f. 6. Med. 40–100 f.; P. 45–50 f.

Venus rudis, Poli. Ph. i. 40, t. 4. f. 8 (*Cytherea venetiana*), and ii. 32. Med. 40–100 f.; Æg. 130 f.; Marm. 20 f.

V. fasciata, Da C. B. C. ii. 334, and v. 184, pl. 38. f. 4. Med. 40–60 f.; Æg. 130 f.; P. 60–80 f.

V. casina, L. B. C. ii. 337, and v. 184, pl. 38. f. 5. Med. 40–100 f.

V. verrucosa, L. B. C. ii. 339, and v. 184, pl. 38. f. 6. Med. 40 f.

V. cygnus, Lam. Ph. i. 42 (*Cytherea rugosa*), and ii. 32 (*C. multilamella*?). Med. 40–100 f.

V. effossa, Biv. Ph. i. 43, t. 3. f. 20, and ii. 34. Med. 50–100 f. A true *Venus*, but very distinct from the last species.

V. ovata, Pennant. B. C. ii. 342, and v. 184, pl. 39. f. 1. Med. 30–100 f.; Æg. 130 f.; Marm. 20 f.; P. 10–1366 f.

Tapes aureus, Gm. B. C. ii. 349, and v. 185, pl. 39. f. 4. Med. 40–100 f.; P. 3 f.

Lucinopsis undata, Penn. B. C. ii. 363, and v. 186, pl. 40. f. 1. Med. 40 f.; P. 40–1366 f.

Tellina balaustina, L. B. C. ii. 371, and v. 186, pl. 40. f. 3. Med. 40–100 f.; Æg. 130 f.; Marm. 20 f.; P. 45–420 f.

T. crassa, Penn. B. C. ii. 373, and v. 186, pl. 40. f. 4. Med. 40 f.

T. donacina, L. B. C. ii. 386, and v. 187, pl. 41. f. 4. Med. 40–100 f.; and var. *distorta*.

T. pusilla, Ph. B. C. ii. 388, and v. 187, pl. 41. f. 5. Med. 40–100 f.; P. 74–290 f.

T. serrata (Renier), Brocchi. Ph. i. 25, and ii. 21. Med. 50–100 f.; Marm. 20 f.

Psammobia costulata, Turt. B. C. ii. 394, and v. 187, pl. 42. f. 2. Med. 40 f.; P. 85 f.

P. ferröensis, Ch. B. C. ii. 396, and v. 187, pl. 42. f. 3. Med. 40–100 f.; Marm. 20 f.; P. 10–208 f.

Scrobicularia prismatica, Mont. B. C. ii. 435, and v. 189, pl. 45. f. 1. Med. 30–100 f.; P. 40–517 f.

S. nitida, Müll. B. C. ii. 436, and v. 189, pl. 45. f. 2. Med. 30 f.; P. 3–2435 f.

Scrobicularia alba, W. Wood. B. C. ii. 438, and v. 189, pl. 45. f. 3. Med. 40–310 f.; Æg. 130–250 f.; Marm. 20 f.; P. 40–517 f.

Solecurtus antiquatus, Pulteney. B. C. iii. 6, and v. 190, pl. 46. f. 2. Med. 50–100 f.

Pandora inæquivalvis, L., var. *pinna*. B. C. iii. 24, and v. 190, pl. 48. f. 1[a]. Med. 30–100 f.; Æg. 130 f.; P. 45–420 f.

Thracia papyracea, Poli. B. C. iii. 36, and v. 191, pl. 48. f. 4. Med. 40 f.; P. 64–164 f.

T. pubescens, Pult. B. C. iii. 38, and v. 191, pl. 48. f. 5. Æg. 130 f.

Poromya granulata, Nyst & Westendorp. B. C. iii. 45, and v. 191, pl. 49. f. 1. Med. 50–100 f.; P. 110–420 f.

Neæra abbreviata, Forb. B. C. iii. 48, and v. 191, pl. 49. f. 2. Æg. 250 f.; P. 165–183 f.

N. costellata, Deshayes. B. C. iii. 49, and v. 191, pl. 49. f. 3. Med. 50–100 f.; Æg. 130–250 f.; P. 96–664 f.

N. rostrata, Spengler. B. C. iii. 51, and v. 191, pl. 49. f. 4. Med. 30 f.; Æg. 250 f.; P. 85–183 f.

Verticordia granulata, Seguenza, Journ. de Conch. 2e sér. iv. 293, pl. 10. f. 2 *f–h*. Æg. 130 f. Hitherto known only as a Sicilian fossil. The hinge of the right valve is furnished with a small but distinct and prominent tubercular tooth, which is curved, and fits like a bolt into a triangular notch or cavity in the hinge of the other valve; and it has also a long lateral ridge and furrow on the anterior or broader side. This species is undistinguishable (except in its smaller size) from *V. multicostata* of A. Adams, a North-Japanese shell. The venerable and excellent conchologist, Dr. Lea, having kindly sent me a specimen of his *Hippagus isocardioïdes*, I am enabled to state that, in my opinion, it belongs to the genus *Crenella*, as represented by *C. glandula* of Totten.

Corbula gibba, Olivi. B. C. iii. 56, and v. 192, pl. 49. f. 6. Med. 30–100 f.; Æg. 130 f.; Marm. 20 f.; P. 3–1476 f.

Saxicava rugosa, L.; var. *arctica*. B. C. iii. 82, and v. 192, pl. 51. f. 4. Med. 40–100 f.; P. 15–420 f.

Venerupis substriata, Mont. Ph. i. 22, t. 3. f. 5, and ii. 20 (*V. decussata*); B. C. iii. 88. Æg. 130 f.

Solenoconchia.

Dischides Olivi, Sc. Notizie geologiche, 56, t. 2. f. 6; B. C. iii. 171, and v. 194 (*D. bifissus*). Med. 30–100 f. *Denta-*

lium coarctatum, Ph. (but not of Lamarck, Brocchi, or Deshayes, which is a species of *Cadulus*) = *D. bifissum*, S. Wood.

Cadulus subfusiformis, Sars. B. C. v. 196, pl. 101. f. 3. Med. 50–100 f.; Æg. 100–250 f.; P. 114–1180 f.

Siphonodentalium lofotense, Sars. B. C. v. 195, pl. 101. f. 2. Med. 50–100 f.; Æg. 130–250 f.; P. 30–1180 f.

S. quinquangulare, Forb. B. A. Rep. 1843, 188. Med. 50–310 f.; Æg. 130–250 f.; P. 40–725 f. *S. pentagonum*, Sars.

Dentalium dentalis, L.; and var. *novemcostata*. Ph. i. 243, and ii. 206; B. C. iii. 196, 197, and v. 197. Med. 30–100 f.; Marm. 20 f.

D. abyssorum, Sars, var. *agilis*. B. C. iii. 197, and v. 197, pl. 101. f. 1. Med. 310 f.; P. 45–1476 f. *D. incertum*, Ph. (not Desh.) = *D. striatum*, Sc. (not Lam.) = *D. agile*, Sars.

D. tarentinum, Lam. B. C. iii. 195, and v. 197, pl. 55. f. 2. Med. 40 f.

*D. gracile**, Jeffr.

SHELL extremely narrow and slender, gently curved, thin, nearly transparent, and glossy: *sculpture*, slight concentric lines of growth, which are scarcely perceptible: *colour* clear white: *margin* at the anterior end more or less jagged, owing to its excessive tenuity and fragility; at the posterior end truncated, with an internal pipe, and slightly notched; in the fry this latter part has a pear-shaped and perforated point. L. 0·5, B. 0·05.

Med. 310 f.; Æg. 100–250 f.; Vigo (M'Andrew).

Mr. M'Andrew tells me that the animal was of a greenish colour. Not *D. filum* of G. B. Sowerby, jun., from the Philippine Islands, in the late Mr. Cuming's collection, nor the young of *D. rubescens*. The present species is more regularly cylindrical, narrower, and nearly equal in breadth throughout. It is curved, which shows that it is adult, the very young of all species of *Dentalium* being almost straight.

GASTROPODA.

Chiton fascicularis, L. B. C. iii. 211, and v. 197, pl. 55. f. 3. Med. 50–100 f.; P. 10 f. Of this and the following three species valves only occurred in the Mediterranean dredgings.

C. siculus, Gray. Ph. i. 106, t. 7. f. 3 (*C. squamosus*), and ii. 82; B. C. v. 199. Med. 50–100 f.

C. Polii, Ph. i. 106, and ii. 83. Med. 50–100 f.

C. variegatus, Ph. i. 107, and ii. 83, t. 19. f. 13. Med. 40 f.

* Slender.

Tectura virginea, Müll. B. C. iii. 248, and v. 200, pl. 58. f. 4. Med. 40–60 f.; P. 10 f.

Gadinia Gussonii, Sc. Oss. zool. Pantellaria, 10. no. 21 (*Ancylus? Gussonii*); Ph. i. 111, t. 7. f. 7 (*Patella pellucida*), and ii. 84 (*P. Gussonii*). Med. 40 f.; Corsica (Susini); Madeira (M'Andrew & Watson); Canaries (M'Andrew).—*G. excentrica*, Tiberi. This genus appears to belong to the *Fissurellidæ*.

G. Garnoti, Payraudeau. Ph. i. 111, and ii. 85. Med. 40 f.

Emarginula rosea, Bell. B. C. iii. 261, and v. 200, pl. 59. f. 3. Med. 40 f.

E. adriatica, Costa. Ph. i. 114, t. 7. f. 15, and ii. 89 (*E. cancellata*); B. C. v. 200. Med. 40 f.; Æg. 100–250 f.

E. Huzardi, Payr. Ph. i. 115 (*E. Huzardii*), and ii. 89. Med. 40 f.

E. elongata, Costa. Ph. i. 115, t. 7. f. 13, and ii. 89. Med. 40 f.

Fissurella græca, L. B. C. iii. 266, and v. 200, pl. 59. f. 5. Med. 40–100 f.

F. nubecula, L. Ph. i. 117 (*F. nimbosa*), and ii. 91 (*F. rosea?*); B. C. iii. 267, 268, and v. 201. Med. 50–100 f.

Capulus hungaricus, L. B. C. iii. 269, and v. 201, pl. 59. f. 6. Med. 40 f.; P. 30–180 f.

Calyptræa chinensis, L. B. C. iii. 273, and v. 201, pl. 60. f. 1. Med. 40–100 f.; Æg. 130 f.

Crepidula unguiformis, Lam. Ph. i. 120, and ii. 93; and var. *fulvo-lineata*. Med. 40 f.

Scissurella crispata, Fleming. B. C. iii. 283, and v. 201, pl. 60. f. 3. Med. 40–60 f.; Æg. 100–250 f.; P. 164–725 f.

Cyclostrema nitens, Ph. B. C. iii. 289, and v. 201, pl. 61. f. 2. Æg. 250 f.

C. serpuloïdes, Mont. B. C. iii. 290, and v. 201, pl. 61. f. 3. Med. 40 f.

Trochus magus, L. B. C. iii. 305, and v. 203, pl. 62. f. 1. Med. 40–100 f.

T. striatus, L. B. C. iii. 322, and v. 203, pl. 63. f. 2. Med. 40 f.

T. exasperatus, Penn. B. C. iii. 324, and v. 203, pl. 63. f. 3. Med. 40–100 f.

T. millegranus, Ph. B. C. iii. 325, and v. 204, pl. 63. f. 4. Med. 40–60 f.; Æg. 130 f.; Marm. 20 f.; P. 45–190 f.

T. zizyphinus, L. B. C. iii. 330, and v. 204, pl. 63. f. 6. Med. 40–100 f.; Æg. 100–130 f.; P. 10–50 f.

T. conulus, L. Ph. i. 175, and ii. 149; B. C. iii. 332, 333. Med. 40 f.

Clanculus Jussiæi, Payr. Ph. i. 186, and ii. 157 (*Monodonta Jussieui*). Med. 40 f.

C. corallinus, Gm. Ph. i. 186 (*Monodonta Coutourii*), and ii. 157. Med. 40 f.

Craspedotus limbatus, Ph. ii. 157, t. 25. f. 19; B. C. v. 204. Med. 40 f.; Æg. 100–250 f.; P. 155 f.; Mediterranean cable, 1100 f. (A. Milne-Edwards).

Phasianella pulla, L., var. *tenuis*. B. C. iii. 338, and v. 204, pl. 64. f. 1. Med. 40 f.

P. speciosa, v. Mühlfeld. Ph. i. 188 (*P. Vieuxii*), and ii. 158. Med. 40 f.

Turbo rugosus, L. Ph. i. 173, and ii. 151 (*Trochus*). Med. 40 f.

T. sanguineus, L. Ph. i. 179, and ii. 151 (*Trochus*). Med. 30–100 f.

Fossarus costatus, Brocchi. Ph. ii. 148, t. 25. f. 5 (*F. clathratus*). Med. 60 f.

F. Petitianus, Tiberi, Journ. de Conch. xvi. 179. Med. 40 f.

*Hela**, gen. nov.

SHELL shaped like that of *Lacuna*, with a similar operculum; but it has no epidermis. The apex is truncated or flattened, and instead of an umbilical canal or groove, there is merely a narrow chink. The tentacles are ciliated, as in *Trochus* and *Rissoa*.

H. tenella, Jeffr. B. C. v. 204, pl. 101. f. 7 (*Lacuna*). Med. 310 f.; P. 420–862 f.

Rissoa cancellata, Da C. B. C. iv. 8, and v. 207, pl. 66. f. 3. Med. 40–100 f. This and many of the following species of *Rissoa* were probably drifted out to sea by the tide and currents.

R. Oceani, D'Orbigny = *R. crenulata*, var. *minor*, Ph. ii. 126. Med. 40–60 f.

R. calathus, Forbes & Hanley. B. C. iv. 11, and v. 207, pl. 66. f. 4. Med. 40–60 f.

R. reticulata, Mont. B. C. iv. 12, and v. 207, pl. 66. f. 5. Med. 40–100 f.

R. cimicoïdes, Forb. B. C. iv. 14, and v. 207, pl. 66. f. 6. Med. 40–310 f.; Æg. 100–250 f.; P. 90–422 f.

R. punctura, Mont. B. C. iv. 17, and v. 207, pl. 66. f. 8. Med. 30–100 f.; Æg. 130 f.; P. 25–33 f.

R. scabra, Ph. ii. 126, t. 23. f. 8; and var. *major*. Med. 40 f.

R. abyssicola, Forb. B. C. iv. 19, and v. 207, pl. 66. f. 9.

* The Scandinavian Proserpine. See Gray's 'Descent of Odin:
"Hela's dread abode."

P. 165 f. Var. 1, *obtusa.* Shell regularly oval, with a shorter spire and less oblique outline. Med. 50–310 f. Var. 2, *conformis.* Med. 30–100 f. (Nares); 350 f. (Spratt). This latter variety is common throughout the Mediterranean, and may be a distinct species. The sculpture is stronger, and the reticulation more remote; the spire is more sharply pointed, and the outer lip is not so much expanded as in the typical form. The throat or inside of the outer lip is smooth in all the forms.

Rissoa zetlandica, Mont. = *R. clathrata*, Ph. B. C. iv. 20, and v. 207, pl. 67. f. 1. Med. 60 f.; P. 173–208 f. (in the last Number of the 'Annals' 808 was erroneously given for 173 f.).

R. Philippiana, Jeffr. Ann. & Mag. N. H. ser. 2. xvii. 183, pl. 2. f. 4, 5; var. *tessellata* (*Alvania tessellata*, Schwartz). Shell somewhat larger and more solid than usual. Med. 50–100 f. Perhaps *R. Lancei*, Calcara.

R. areolata, Ph. ii. 132, t. 23. f. 23. Med. 50–100 f.; Naples and Sicily (Stefanis and Monterosato).

R. dictyophora, Ph. ii. 128, pl. 23. f. 11; and var. *Weinkauffi* (*Alvania Weinkauffi*, Schw.). Med. 40 f.

R. costata, Adams. B. C. iv. 22, and v. 207, pl. 67. f. 2. Med. 40 f.

R. parva, Da C. B. C. iv. 23, and v. 207, pl. 67. f. 3. Med. 40–60 f.; P. 0–10 f.

R. pulchella, Ph. i. 155, t. 10. f. 12, and ii. 127; var. *minor.* Smaller and spirally striated, with a labial rib. Med. 40 f.

R. nana, Ph. i. 154, t. 10. f. 3 (*R. pusilla*), and ii. 127 (1844). Med. 40 f. If this be the *R. pulchra* of Forbes (1843), his name would take precedence of *nana*; Nyst's work, in which he changed the specific name to *dolium*, was not published till 1845.

R. inconspicua, Alder. B. C. iv. 26, and v. 207, pl. 67. f. 5. Med. 40–100 f.; Æg. 100 f.; P. 3 f.

R. auriscalpium, L. Ph. i. 151 (*R. acuta*), and ii. 125, t. 23. f. 2. Med. 40 f.

R. variabilis, v. Mühlf. Ph. i. 149, and ii. 123 (*R. costata*). Med. 40 f.

R. membranacea, Ad. B. C. iv. 30, and v. 208, pl. 67. f. 8. Med. 40 f.

R. violacea, Desmarets. B. C. iv. 33, and v. 208, pl. 67. f. 9. Med. 40 f.

R. costulata, Ald. B. C. iv. 35, and v. 208, pl. 68. f. 1; var. *similis.* Med. 40 f.

R. vitrea, Mont. B. C. ii. 40, and v. 208, pl. 68. f. 4. Med. 60 f.; P. 25–40 f.

Rissoa soluta, Ph. B. C. iv. 45, and v. 208, pl. 68. f. 7. Med. 40–100 f.; Æg. 130 f.

R. semistriata, Mont. B. C. iv. 46, and v. 208, pl. 68. f. 8. Med. 40 f.

Rissoina decussata, Mont. Ph. i. 153, and ii. 130 (*Rissoa Bruguieri*). Med. 40 f.

Barleeia rubra, Mont. B. C. iv. 56, and v. 209, pl. 69. f. 4. Med. 40–100 f.; drifted?

Skenea planorbis, Fabricius. B. C. iv. 65, and v. 209, pl. 70. f. 1. Med. 30 f.; drifted?

Cæcum trachea, Mont. B. C. iv. 75, and v. 209, pl. 70. f. 4. Med. 50–100 f.

Vermetus subcancellatus, Biv. Ph. i. 172, t. 9. f. 20, and ii. 144. Med. 40 f.; Æg. 100 f.

Siliquaria anguina, L. Ph. i. 173, t. 9. f. 24 *a–c*, and ii. 144. Med. 60 f.

Turritella terebra, L. B. C. iv. 80, and v. 209, pl. 70. f. 6. Med. 30–100 f.; Marm. 20 f.; P. 10–422 f.

Mesalia? pusilla, Jeffr. Ann. & Mag. N. H. ser. 2. xvii. 184, pl. 2. f. 10, 11 (*Turritella?*). Med. 30–100 f. Although the sculpture is that of some species of *Cerithium*, the mouth is entire and not grooved at the base.

Scalaria clathratula, Ad. B. C. iv. 96, and v. 210, pl. 71. f. 5. Med. 30–100 f.

S. pulchella, Biv. Ph. i. 168, t. 10. f. 1, and ii. 145. = *S. Schultzii*, Weink. Med. 40–60 f.; Æg. 100–130 f. The spiral striæ not having been noticed by Bivona or Philippi, I thought this might be *S. clathratula*; but the greater closeness of the ribs otherwise distinguish it from that species.

S. hellenica, Forb., B. A. Rep. (1843), 189. = *Rissoa? coronata* (Sc.), Ph. = *S. Scacchii*, Hörnes? Med. 40 f.; Canary Isles (M'Andrew). Specimens from the latter locality are half an inch long.

Aclis Walleri, Jeffr. B. C. iv. 105, and v. 210, pl. 72. f. 4. Æg. 130 f.; P. 422–1380 f.

Odostomia pallida, Mont. B. C. iv. 124, and v. 211, pl. 73. f. 5. Æg. 130 f.

O. conoïdea, Brocchi. B. C. iv. 127, and v. 211, pl. 73. f. 6. Med. 40–100 f.; Æg. 130 f.; P. 25–208 f.

O. acuta, Jeffr. B. C. iv. 130, and v. 211, pl. 73. f. 8. Med. 30 f.

O. unidentata, Mont. B. C. iv. 134, and v. 211, pl. 74. f. 1. Med. 40–60 f.; P. 30–40 f.

O. turrita, Hanley. B. C. iv. 135, and v. 211, pl. 74. f. 2. Med. 30–40 f.; Æg. 130 f.

Odostomia diaphana, Jeffr. B. C. iv. 141, and v. 212, pl. 74. f. 5. Med. 30–40 f.

O. interstincta, Mont. B. C. iv. 151, and v. 213, pl. 75. f. 2. Med. 30–310 f.; Æg. 250 f.

O. excavata, Ph. B. C. iv. 158, and v. 213, pl. 75. f. 6. Med. 40 f.

O. scalaris, Ph. B. C. iv. 160, and v. 213, pl. 75. f. 7. Med. 40 f.

O. rufa, Ph. B. C. iv. 162, and v. 213, pl. 76. f. 1. Med. 50–100 f.; P. 25–208 f.

O. lactea, L. B. C. iv. 164, and v. 213, pl. 76. f. 3. Med. 40 f.; P. 15–20 f.

O. pusilla, Ph. B. C. iv. 167, and v. 213, pl. 76. f. 4. Med. 30–100 f.

O. acicula, Ph. B. C. iv. 170, and v. 213, pl. 76. f. 6. Med. 30–310 f.; Æg. 100–250 f.; P. 25–1366 f.

*O. nitens**, Jeffr.

SHELL oblong, or forming a long oval, rather thin, semitransparent, and very glossy: *sculpture* none, except microscopic lines of growth: *colour* clear white: *spire* bluntly pointed; nucleus inverted: whorls three only (besides the nucleus), moderately convex; the last occupies two-thirds of the spire: *suture* very narrow and slightly excavated; it is apparently margined by the overlapping of each successive whorl in that part: *mouth* oval, contracted above and on the outer side, and somewhat channelled below, length about one-third of the spire: *outer lip* thin, sloping downwards: *inner lip* distinct: *pillar* twisted: *umbilicus* none: *tooth* represented by a broad but not conspicuous fold. L. 0·1, B. 0·035.

Æg. 130 f. Its nearest ally is *O.* (*Syrnola*) *minuta* of H. Adams, which I have from Corsica; that shell, however, is cylindrical, with more whorls, a golden band encircling the periphery, and a strong tooth.

O. tricincta, Jeffr. Ann. & Mag. N. H. ser. 2. xvii. 185, pl. 2. f. 12, 13. Med. 40–100 f.

O. striatula, L., Syst. Nat. ii. 1238; Ph. i. 157, t. 9. f. 8, and ii. 136 (*Chemnitzia pallida*); B. C. iv. 7. Med. 30–100 f. Not my *Eulimella striatula* (Piedmontese Mollusca), which must have another name, say *hyalina*. One specimen of the present species has the outer lip crenated or toothed on the inside, as in *Chemnitzia costaria* of S. Wood, which in other particulars agrees with the recent shell.

Pyramidella læviuscula, S. Wood, Cr. Moll. 77, pl. 9. f. 2 *a, b*.

* Shining.

=*Turbo terebellatus* of Brocchi, not *Auricula terebellata* of Lamarck. Med. 50–100 f. Another case of the revival of a species supposed to be extinct.

Mathilda quadricarinata, Brocchi. Ph. i. 191, and ii. 160 (*Turritella*). =*Eglisia Macandreæ*, H. Adams. Med. 40–100 f.

Eulima polita, L. B. C. iv. 201, and v. 214, pl. 77. f. 3. Med. 40–100 f.

E. intermedia, Cantraine. B. C. iv. 203, and v. 214, pl. 77. f. 4. Med. 40 f.

E. distorta, Desh.; and var. *gracilis*. B. C. iv. 205, and v. 214, pl. 77. f. 5. Med. 30–100 f.; Æg. 130 f.; P. 15–164 f.

E. stenostoma, Jeffr. B. C. iv. 207, and v. 215, pl. 77. f. 6. Med. 310 f.; P. 64–290 f.

E. subulata, Donovan. B. C. iv. 208, and v. 215, pl. 77. f. 7. Med. 50–100 f.; P. 15–40 f.

E. bilineata, Ald. B. C. iv. 210, and v. 215, pl. 77. f. 8. Med. 50–100 f.; Æg. 130 f.; P. 40–422 f.

E. Jeffreysiana, Brusina. Journ. de Conch. xvii. 245 (*Leiostraca*). Med. 40–100 f.; Canary Isles (M'Andrew)!

E. microstoma, Brus. *l. c.* 244. Med. 40 f.; Canary Islands (M'Andrew)!

A fragment (the last whorl) of another and a remarkable species of (apparently) *Eulima* occurred in the Tunis-Bay dredging at a depth of 30 fathoms. It would be about the size of *E. subulata*, and is cream-coloured, with longitudinal, slight, and flattened ribs, and a few spiral striæ at the base; the lower part of the inner lip is thickened and reflected. If a perfect specimen should be found, it might take the name of *cœlata*.

Natica fulminea, Risso, Hist. Nat. de l'Eur. mér. iv. 149 (*Nacca*). = *N. lineolata* and *N. filosa*, Ph. = *N. Sagraiana*, M'Andr., not D'Orb. Med. 50–100 f.

N. intricata, Don. Ph. i. 162 (*N. Valenciennesii*), and ii. 140. Med. 40 f.

N. Dillwyni, Payr. Ph. i. 162, and ii. 140. Med. 40 f.

N. Alderi, Forb. B. C. iv. 224, and v. 215, pl. 78. f. 5. Med. 50–100 f.; P. 10–420 f.

N. Guillemini, Payr. Ph. i. 162, and ii. 140 f. Med. 40–100 f.

Neritina viridis, L. Ph. i. 159, and ii. 138. Med. 40 f.; drifted?

Solarium Architæ, Costa. Ph. i. 173, and ii. 148 (*S. stramineum*). = *S. fallaciosum*, Tib. Med. 50–100 f.; P. 140 f. According to Weinkauff, this species is the *S. siculum* of

Cantraine; but Petit refers the latter to the next species. Cantraine's descriptions are very unsatisfactory.

Solarium hybridum, L. Ph. i. 174, t. 10. f. 27, and ii. 148 (*S. luteum*). Med. 50–100 f.

Aporrhaïs pes-pelecani, L. B. C. iv. 250, and v. 216, pl. 80. f. 1. Med. 60 f.; Marm. 20 f.; P. 10–422 f.

A. Serresianus, Michaud. Ph. ii. 185, t. 27. f. 6. (*Chenopus*). Med. 50–100 f.; P. 45–458 f.

Cerithium tuberculatum, L. Ph. i. 192, t. 11. f. 3–6, and ii. 161 (*C. vulgatum*); B. C. iv. 264, and v. 217. Med. 40 f.

C. lacteum, Ph. i. 195, and ii. 162. = *C. elegans*, De Blainville, not Desh. Med. 40 f.

C. reticulatum, DaC. B. C. iv. 258, and v. 217, pl. 80. f. 4. Med. 40–100 f.; Æg. 130 f.; P. 3–74 f.

Triforis perversa, L. B. C. iv. 261, and v. 217, pl. 80. f. 5. Æg. 100–130 f.

Cerithiopsis tubercularis, Mont. B. C. iv. 266, and v. 217, pl. 81. f. 1. Med. 30–100 f.

C. pulchella, Jeffr. B. C. iv. 269, and v. 217, pl. 81. f. 3. Med. 40 f.

C. Metaxa, Delle Chiaje. B. C. iv. 271, and v. 217, pl. 81. f. 4. Med. 40–100 f. Delle Chiaje expressly mentions four rows of tubercles (which this species possesses), *C. tubercularis* having three only; and his figures exactly suit the present species.

Triton reticulatus, DeBl. Ph. i. 211, t. 11. f. 28, and ii. 183 (*Ranella lanceolata*). Med. 40 f.

Murex lamellosus, Cristofori & Jan. Ph. i. 204, t. 11. f. 30, and ii. 179 (*Fusus*). =? *M. brevis*, Forb. Med. 50–100 f.; Mediterranean cable, 1100 f. (A. Milne-Edwards); P. 80–110 f. *M. imbricatus* of Brocchi seems to differ only in its much larger size.

M. cristatus, Brocchi. Ph. i. 209, and ii. 182. Med. 40–100 f.; Æg. 100 f.

M. aciculatus, Lam. B. C. iv. 310, and v. 218, pl. 84. f. 2. Med. 40 f.

Lachesis minima, Mont. B. C. iv. 313, and v. 218, pl. 84. f. 3; and var. *mammillata*. Med. 40–100 f.

L. Folineæ, D.Ch. Ph. ii. 189, t. 27. f. 10. Med. 40 f.

Trophon muricatus, Mont. B. C. iv. 318, and v. 218, pl. 84. f. 5. Med. 60–310 f.; Æg. 250 f.; P. 15–458 f.

T. vaginatus, Crist. & Jan. Ph. i. 211, t. 11. f. 27, and ii. 182 (*Murex*). Med. 310 f.; Æg. 250 f. This and the following two species appear to belong to the genus *Trophon*. See B. C. iv. 315.

T. syracusanus, L. Ph. i. 203, and ii. 177. Med. 40–310 f.

Trophon craticulatus, Brocchi. Ph. i. 204, and ii. 178. Med. 40–100 f.

Pisania cornea, L. Ph. i. 202 (*Fusus lignarius*), and ii. 177. Med. 40 f.

Cassidaria tyrrhena, Ch. Ph. i. 216, and ii. 186. Med. 60 f.; P. 458–725 f.

Nassa incrassata, Ström. B. C. iv. 351, and v. 219, pl. 88. f. 1. Med. 30–40 f.; P. 10–40 f.

N. limata, Ch. Ph. i. 219, and ii. 188 (*Buccinum prismaticum*). Med. 40–310 f.; and var. *striata*, without ribs. Med. 50–100 f.

Columbella scripta, L. Ph. i. 225 (*Buccinum Linnæi*), and ii. 190. Med. 40–100 f.

C. minor, Sc. Ph. ii. 190, t. 27. f. 12. Med. 40 f.

C. rustica, L. Ph. i. 228, t. 12. f. 11, and ii. 194. Med. 40 f.

Defrancia teres, Forb. B. C. iv. 362, and v. 219, pl. 88. f. 5. Med. 50–100 f.; Æg. 130 f.; P. 30–345 f.

D. gracilis, Mont. B. C. iv. 363, and v. 219, pl. 88. f. 6. Med. 40–60 f.; P. 13–173 f.

D. Leufroyi, Mich. B. C. iv. 366, and v. 219, pl. 89. f. 1. Med. 310 f.; Æg. 130–250 f.

D. linearis, Mont. B. C. iv. 368, and v. 220, pl. 89. f. 2. Med. 60 f.; P. 13–173 f.

D. reticulata (Renier), Bronn. B. C. iv. 370, and v. 220, pl. 89. f. 3, 4. Med. 50–100 f. This specific name has been so long in use, that it may be unwise to change it; but as it was not accompanied by a description or figure, Brocchi's name *echinata* is in strictness preferable.

D. hystrix, Jan. Bellardi, Mon. Pleur. foss. Piem. 613, t. 4. f. 14. Med. 40–100 f. Not *D. reticulata*, var. *formosa*, which (although it has also a spiny sculpture) is much larger and not so slender, with proportionally more transverse ridges; and it especially has the apex conical and reticulated, the apex in the present species being twisted and spirally striated, like that of *Trophon*. Forbes's *Pleurotoma reticulata*, var. *spinosa*, may belong to either species; it was dredged by him (according to Reeve) off the coast of Nice, at the depth of from 5 to 40 fathoms. *P. spinulosa* of Risso and *P. spinosa* of De Blainville are evidently the variety of *D. reticulata*, as, indeed, the last-named author suspected. I have to thank Dr. Tiberi for calling my attention to this question in the 'Bulletino Malacologico Italiano' for 1869, p. 261. Several localities are given by him for *D. hystrix*, as recent and tertiary.

D. purpurea, Mont., var. *Philberti*. B. C. iv. 373, 374, and v. 220, pl. 89. f. 5. Med. 40 f.; P. 30–40 f.

Pleurotoma crispata, Jan. Ph. i. 200, and ii. 170, t. 26. f. 12. Med. 40–100 f.; Æg. 130–250 f.

P. striolata (Sc.), Ph. B. C. iv. 376, and v. 220, pl. 90. f. 1. Med. 40 f.; P. 15–20 f. Apparently *P. Loeviana* of Reeve; but his descriptions are very insufficient, and his figures often more picturesque than scientifically exact.

P. costata, Don. B. C. iv. 379, and v. 220, pl. 90. f. 3. Med. 40–100 f.; P. 10–208 f.

P. Vauquelini, Payr. Ph. i. 198, t. 11. f. 19, and ii. 167. Med. 40 f.

P. brachystoma, Ph. B. C. iv. 382, and v. 220, pl. 90. f. 5. Med. 50–100 f.; P. 15–40 f.

P. nebula, Mont. B. C. iv. 384, pl. 91. f. 1. Med. 40 f.; P. 13–40 f.

P. galerita, Ph. ii. 172, t. 26. f. 15; B. C. v. 221, pl. 102. f. 6. Med. 50–100 f. A fragment, but unmistakable.

P. carinata, Biv. B. C. v. 221, pl. 102. f. 7. Med. 310 f.; P. 80–664 f.

P. septangularis, Mont. B. C. iv. 390, 392, and v. 222, pl. 91. f. 5; var. *secalina*. =*P. ægeensis*, Forb. ex typ. Med. 40–100 f.

P. nana, Sc. Ph. ii. 169, t. 26. f. 11. =*P. fortis*, Forb. Med. 40 f.

P. clathrata, Marcel de Serres. Ph. i. 199, t. 11. f. 16 (*P. rude*), and ii. 170 (*P. granum*). Med. 40–60 f. *P. delosensis*, Reeve, from Forbes's Ægean dredgings.

There is also a young specimen of a *Pleurotoma*, from 250 f. in the Ægean, which I cannot identify with any living or fossil species. It is rather solid for its size, and has numerous fine curved longitudinal ribs. Not the young of the next species, in which the ribs are much broader and straight at the same period of growth.

Conopleura elegans, Sc. Ph. ii. 168, t. 26. f. 5. =*Pleurotoma incisa*, Reeve. Med. 40–100 f.; Marm. 20 f.; and var. *nana*, Med. 40 f. Hind's genus *Conopleura* seems a good one, by reason of the peculiar characters afforded by the apex and the tubercular process on the pillar. *P. sigmoïdea* of Bronn is congeneric.

Conus mediterraneus, Brug. Ph. i. 238, t. 12. f. 16–22, and ii. 200. Med. 40 f.

Cancellaria cancellata, L. Ph. i. 201, and ii. 176. Med. 50–100 f.

C. coronata, Sc. Ph. ii. 177, t. 25. f. 27. Med. 50–100 f.; a fragment.

Ringicula auriculata, Menard de la Groye. Ph. i. 231, and ii. 198. Med. 40–100 f.; Gulf of Suez (M'Andrew)!

According to Bronn, this is the *Voluta buccinata* of Renier; but the latter neither described nor figured it.

Ringicula ventricosa, J. Sow. S. Wood, Cr. Moll. 22, pl. 4. f. 1 *a*, *b*. =*R. striata*, Ph. Med. 310 f.; P. 557 f.

Mitra columbellaria, Sc. Ph. i. 230 (*M. obsoleta*), and ii. 195, t. 27. f. 17. Med. 40–100 f.

M. tricolor, Gm. Ph. i. 230, and ii. 195 (*M. Savignyi*). Med. 40 f.; var. *granum*, rather larger and broader, with the pillar-folds also strong and conspicuous = *M. granum*, Forb. Med. 40–100 f.

M. cornicula, L. Ph. i. 229, t. 12. f. 9, 10, and ii. 195 (*M. ebenus*). Med. 40 f.; var. *minor* = *M. Philippiana*, Forb.; young = *M. littoralis*, Forb., ex typ.

M. lutescens, Lam. Ph. i. 229 (*M. cornea*), and ii. 195. Med. 40–100 f.; P. 200–420 f. *Volutomitra grœnlandica* of Gray, and probably *Voluta tringa* of Linné.

Marginella secalina. Ph. i. 232 (*Volvaria triticea*), and ii. 197, t. 27. f. 19. Med. 40–100 f.

M. clandestina, Brocchi. Ph. i. 231, and ii. 197. Med. 40–100 f.; Æg. 130 f. Var. *major*. Med. 40 f.

M. occulta, Monterosato, Testacei nuovi dei mari di Sicilia (Palermo, 1869, 8vo), 17, f. 10. Med. 50–100 f. I am inclined to consider this distinct from the last species, until an intermediate or connecting form has been found.

M. minuta, L. Pfeiffer. Ph. ii. 197, t. 27. f. 23. Med. 30–100 f.

M. miliaria, L. Ph. i. 232, and ii. 197 (*M. miliacea*). Med. 40–100 f.

M. lævis, Don. B. C. iv. 400, pl. 92. f. 1. Med. 40–100 f.; P. 30–420 f.

Cypræa europæa, Mont. B. C. iv. 403, and v. 222, pl. 92. f. 2. Med. 40–100 f.; P. 10–110 f.

Cylichna umbilicata, Mont. B. C. iv. 413, and v. 223, pl. 93. f. 3. Med. 30–100 f.

C. cylindracea, Penn. B. C. iv. 415, pl. 93. f. 4. Med. 50–100 f.; P. 10–517 f.

Utriculus mammillatus, Ph. B. C. iv. 420, and v. 223, pl. 94. f. 1. Med. 40 f.; P. 25–33 f.

U. striatulus, Forb. B. A. Rep. (1843), 188 (*Bulla*). = *Cylichna pyramidata*, A. Adams = *C. Hoernesi*, Weink. Med. 40–100 f.

U. obtusus, Mont. B. C. iv. 423, and v. 223, pl. 94. f. 3; var. *minor*, apice depresso. Med. 30 f.

Actæon tornatilis, L. B. C. iv. 433, and v. 224, pl. 95. f. 2. Med. 40 f.; P. 13–420 f.

A. pusillus, Forb. B. A. Rep. (1843), 191 (*Tornatella*). Med.

40–310 f. Very different from *A. tornatilis* in size, shape, solidity, and sculpture. Forbes's *T. globulina* appears to be a younger state of *A. pusillus*, having the striæ rubbed down, but showing traces of the puncture-like markings. I have before me the types of this and *A. pusillus*, which I had previously regarded (judging only from the short descriptions or diagnoses) as the young and fry of *A. tornatilis.*

*Actæon exilis**, Jeffr.

SHELL oblong or somewhat spindle-shaped, semitransparent, and glossy: *sculpture*, numerous spiral striæ or impressed lines, which are quite smooth or plain, instead of being punctate as in other species of this genus: *colour* clear white: *spire* elongated, with a blunt apex: *whorls* three, moderately convex; the last occupies three-fourths of the spire; the first is mammiform: *suture* distinct, margined: *mouth* rather narrow, irregularly pear-shaped, expanded at the base; length three-fifths of the shell: *outer lip* gently curved, and folding inwards: *inner lip* folded back on the lower part: *pillar* flexuous: *fold* strong and conspicuous. L. 0·075, B. 0·045.

Med. 310 f. It is not unlike *A. levidensis* of S. Wood, from the Coralline Crag at Sutton; but in that species the suture is deeper (making the spire appear pyramidal), and the striæ are punctate.

Bulla hydatis, L. B. C. iv. 437, and v. 224, pl. 95. f. 3. Med. 40 f.

B. utriculus, Brocchi. B. C. iv. 440, and v. 224, pl. 95. f. 4. Med. 40–310 f.; P. 10–584 f.

Scaphander gibbulus, Jeffr. Ann. & Mag. N. H. ser. 2. xvii. 188, pl. 2. f. 20, 21. =?*Bulla turgidula*, Forb. Med. 40 f.

S. lignarius, L. B. C. iv. 443, and v. 224, pl. 95. f. 5. Med. 60 f.; P. 15–517 f.

Philine scabra, Müll. B. C. iv. 447, and v. 224, pl. 96. f. 4. Med. 310 f.; P. 420–1215 f.

Assiminea littorina, D. Ch. B. C. v. 101, pl. 97. f. 6. Med. 40 f.; drifted?

Atlanta Peroni, Lesueur. Ph. ii. 205. Æg. 100–250 f. This and all the following species belonging to Mollusca which are oceanic or inhabit the surface only of the sea, must have fallen to the bottom after death. The specific gravity of their delicate and almost filmy shells being not much greater than that of sea-water, it is evident that they could not sink to any great depth if the downward pressure

* Slender.

of the ocean were such as is generally supposed. Such physical questions are fully discussed in the Report to the Royal Society of the late exploring expedition in H.M.S. 'Porcupine.'

A. rosea, Les. Voyage sur la Bonite, ii. 377, pl. 19. f. 16–20. Med. 310 f.; Æg. 100–250 f.

Ladas Keraudreni, Les. Ph. ii. 205. =*L. planorboïdes*, Forb. Æg. 130 f.

PTEROPODA.

Embolus rostralis, Souleyet, Voy. Bon. ii. 216, pl. 13. f. 1–10 (*Spirialis*); B. C. v. 114. = ? *Bellerophina minuta*, Forb. Med. 310 f.; Æg. 100–250 f.

Spirialis retroversus, Flem. B. C. v. 115, pl. 98. f. 4. Med. 310 f.; P. 25–173 f.

S. bulimoïdes, Eydoux & Soul. Rev. Zool. (1840) 138; Voy. Bon. ii. 224, pl. 13. f. 35–42. Æg. 100 f.; P. 664 f.

S. physoïdes, Forb. B. A. Rep. (1843), 186 (*Peracle*). Æg. 100 f.

Cavolina tridentata, Forskål. Ph. i. 101, and ii. 70. Med. 50–100 f.; Æg. 130 f.

C. inflexa, Les. Ph. i. 101, pl. 6. f. 18 (*Hyalæa uncinata*), and ii. 71 (*H. vaginella*). Med. 310 f.; Æg. 100–130 f.

C. pyramidata, Browne. B. C. v. 119, pl. 98. f. 6. Med. 40–310 f.; Æg. 130–250 f.; P. 110–1380 f.

C. subulata, Quoy & Gaimard. Ph. ii. 72 (*Cleodora spinifera*). Med. 40–310 f.; Æg. 100–250 f.

C. striata, Rang. Ph. ii. 72 (*Cleodora*). = *Cleodora zonata* (D. Ch.?), Ph. Æg. 250 f.

VI.—*Professor Häckel and Mr. Kent on the Zoological Affinities of the Sponges.* By E. RAY LANKESTER, B.A. Oxon.

IT is scarcely right that the criticisms of my friend Mr. Kent should be the only response called forth in this country by the admirable paper of Häckel, in which he proposes to give the sponges an intelligible position in the classification of organisms. Since others who share Häckel's views have not pointed out the destructible nature of Mr. Kent's position, and since he, by the excellent work which he has been doing in coral-studies, may be judged to have brought as strong a case against Häckel as can be got up on that side of the question, I venture to state in what his objections appear to be unfounded. In the first place, Mr. Kent commences by admitting one of the chief points which Häckel contends for,

viz. the descent of the sponges and corals from a common ancestor, *Protascus*; and he also admits the descent of the Calcispongiæ from the stock-form *Prosycum* (Häck.), derived, but not very far removed, from the ancestral *Protascus*; then, stating that the corals had reached "the very zenith" of their development before the close of the Silurian epoch (a statement which is very far indeed from being supported by the comparison of Silurian with recent corals), he says, whatever may have been the affinities of sponges and corals in past times, the two groups, as they *now* exist, exhibit affinities of analogy only rather than homology. This is a most extraordinary view; for if the sponges and corals inherited a common plan of structure from a common ancestor, no length of time modifying the functions of the parts of that common plan could destroy the homology * of the two; and what we should expect to find, and do find, are affinities of homology and but small affinities of analogy. The chief fallacy of Mr. Kent in his criticism upon Häckel is in mistaking the value of analogical and homological relations, and, indeed, in taking the one for the other. Thus Mr. Kent lays great stress on the food of sponges being taken in by ciliary action, whilst corals use muscular power, and are provided with contractile prolongations of the body-wall to seize food; but this is a mere difference of the function of common parts, and has no homological import. No one thinks of separating certain oligochæt worms, such as *Æolosoma*, which take in their food by ciliary action, from the others which use a powerfully developed suctorial pharynx; nor of detaching the Chætopods with prehensile jaws in their pharynges from those which have none. Mr. Kent's statements with regard to the *voluntary* action of muscular tissue and the *involuntary* action of cilia, and the consequent psychical distinction between sponges and corals, are worthy of remark, because, in the first place, if the distinction be allowed, we have to admit a totally novel differentiating character. Mr. Kent ventures to say that Häckel associates sponges with corals by looking to analogical rather than homological affinities,—and then actually proposes to distinguish them by psychical manifestations. Can any thing be further from homological argument than that which he here uses? Moreover the voluntary nature of muscular action and the involuntary nature of ciliary action cannot be admitted on any terms. It is useless to import the term "voluntary" into the discussion; but it is true that where a nervous system

* In another paper (p. 34) I have discussed the signification of the term homology in evolutional zoology, and have proposed to replace it by the term "*homogeny*," in the particular sense which is above implied.

influences animal movements, it usually operates on muscular tissue, though there are cases (among the Vermes) where the nervous system does directly influence ciliary movement; and in the case of the pigment-corpuscles of the frog's skin we have an example of its influencing the amœboid as distinguished from the ciliary movements of simple protoplasm. The close relation of ciliary and amœboid movements and the gradation, therefore, from cilia to muscular fibre, and consequent insignificance of a distinction based on the substitution of one of these forms of motion for another, has been demonstrated by Professor Häckel's observation of the development of cilia in the embryo of *Siphonophora*, also in Sponges and in certain Monera, on the surface of masses of protoplasm which, as he saw, threw out numerous short pseudopodia, and these pseudopodia gradually assumed the form and movements of cilia. The ciliate Infusoria may certainly be cited as examples of ciliary movements exhibiting a so-called "voluntary" character; and conversely it is not necessary to cite to Mr. Kent the host of examples of involuntary muscular movement, from that of an isolated muscular fibre onwards. So much with regard to a diagnosis which Mr. Kent thinks "may be regarded as of the highest importance." Next, in relation to the differences between the Sponges' canal-system and that of Actinozoa, we find Mr. Kent simply directing his arguments to prove a difference of function between the two, and then turning to us and asking us to admit a great homological distinction between them. The existence of inhalant pores in Sponges and their absence in Actinozoa is the only point of homological distinction of any note which Mr. Kent can find; and this is rendered less broad by the temporary character of the pores in some Calcispongiæ and their actual existence in some Actinozoa. It is simply nothing to the point that there is a current setting one way in Sponges and another way (or no current at all) in Actinozoa, and has no reference to homology, as Mr. Kent must see on reflection. The development of the osculum into an aperture for the inception of masses of food is quite conceivable, especially when we look at such a sponge as *Prosycum*. We must also remember that the currents directed by cilia in the Sponges and the contractile organs round the mouth of Actinozoa are special developments gradually attained by these two diverging stocks which their common parent possessed but in general outline*.

A second source of error in Mr. Kent's conclusions is that

* Dr. Richard Greef has this year described, in 'Kölliker u. Siebold's Zeitschrift,' a very simple form of marine hydroid (*Protohydra Leuckarti*) quite devoid of tentacles or tentacular processes.

he persistently compares extreme forms, and demands an agreement in details where a general agreement is sufficient. This is not the way to investigate or to form a judgment of the relationship of two groups: the points of contact must be looked at; and the outlying diverging members of the two groups compared really do not demand attention, tending as they do to mislead the judgment by their extreme contrast. Thus, were we not well acquainted with a great mass of intermediate forms, we should have great difficulty in enclosing *Amphioxus* and Man in one group. And, to take another case, the sponges and corals present no greater chasm between any two forms than is presented by the Chætopod *Aphrodite* and a *Tænia*-proglottid. No one hesitates to associate the Calcispongiæ with the other sponges; and if it can be shown that the Calcispongiæ are more or less closely allied to some of the Cœlenterata, that demonstration is sufficient *so far* to connect the whole of the sponges and the whole of the Cœlenterata.

A third objection which may be urged against Mr. Kent is the evidence of conservatism (which, indeed, I did not look for in him) and of an undue regard for authority which his paper exhibits, and which does not belong to the spirit of science. The five subkingdoms which have succeeded to Cuvier's four are not ultimate natural facts; they may be doubted, questioned, improved upon, and were two years since almost abandoned by Professor Huxley, who once thought well of them. Change is the method of progress; and if there is a disorderly lumber-room which demands a change more pressingly than any other, it is the Protozoa, embracing as it is sometimes made to do Rhizopoda, Sponges, and Infusoria. It matters very little that Professor Häckel is "entirely upsetting the clear limits by which a subkingdom is marked out and subdivided with the mutual consent of the most eminent naturalists of the day." The eminence of the naturalists in question has small concern for us if Professor Häckel can establish his arguments; and it remains to be seen whether the most eminent naturalists will not rather join Professor Häckel in his work of upsetting.

Fourthly, the clearest evidence of weakness in Mr. Kent's case against Häckel is his assertion that the only thing to be done with the Sponges in classification is to place them in a subkingdom designated Protozoa, in company, we suppose (for Mr. Kent does not say what are the limits of his subkingdom), with Monera, Amœboidea, Foraminifera, Gregarinæ, Radiolaria, and Infusoria. Mr. Kent says that if we view the composite sponge-organism as an aggregation of Amœbæ (or, as Mr. James-Clark would say, as far as the Calcispongiæ are concerned, of flagellate Monades), "the affinity of the Spon-

giadæ to the Protozoa rather than to the Cœlenterata makes itself eminently conspicuous;" and at the same time their points of agreement with Cœlenterata, which he enumerates, "entitle them," he says, "in a natural and morphological system of classification, to be ranked as the highest representatives of the Protozoa." Why, "viewed in this light," the Cœlenterata themselves exhibit greater agreement with the Protozoa than with themselves as usually viewed! And it is not difficult thus to view all organisms as Protozoa, since the common descent of organic beings from unicellular forms is exhibited in all by a more or less cellular structure, many of the cells in all cases agreeing closely with certain free-living amœboid and flagellate forms. The histological differentiation of the Spongiadæ is not so great as in many Cœlenterata*; but it is still carried so far that it would be as justifiable to class a *Hydra* as a compound Protozoon as to place a calcareous sponge in that position.

Mr. Kent's relegation of the sponges to the Protozoa will probably not be agreed to by those who may still question as to what is to be done with them, and hesitate about their affinities with Cœlenterata. There was by no means a rigid alternative, as Mr. Kent seems to have thought; he could have left the Sponges alone, neither grouped as Protozoa nor as Cœlenterata. Professor Huxley long since declared the Protozoa to be as unnaturally heterogeneous a series as Cuvier's Radiata; and two years since, at the College of Surgeons, whilst removing the Infusoria to approximate them to the Vermes, he indicated the Sponges as connected with the ancestry of the Cœlenterata, though he did not definitely part them from their old associates in the lumber-room. That the Sponges cannot rightly be left in this position, must be conceded by all who will look into the question. There is a really enormous gap between Sponges and those Protozoa which come nearest to them. The simplest sponges are aggregates of the second order (that is, aggregates of such units as an *Amœba* or a *Monas*), as are also Mollusks, many Cœlenterates, many Worms, and other forms. The compound Radiolaria and Foraminifera offer also examples of secondary aggregation among Protozoa; but on comparing their state of aggregation with that of the sponge, we perceive at once a vast difference. The first is a simple result of growth producing an accumulation of like parts, which remain attached, but might just as

* What Mr. Kent calls an essentially Protozoic property in sponges (as to the temporary character of certain pores) is the property of sarcodic tissue in all animals; and sponges are largely sarcodic; but this does not make them Protozoic.

well be separated as far as their well-being is concerned. In the Sponge, on the contrary, a new principle is detected at work: the aggregation is arranged so that the parts may work for the life of the whole; there is *differentiation* and *individualization*; and this process is carried to a very high degree; so that we have endoderm and ectoderm, fibrous tissue, sarcodine, spicular layers, antimera, ciliated tracts, a canal-system with pores and osculum, and such complete highly individualized forms as *Euplectella* and *Grantia*. There is not the slightest trace of an approach to this kind of thing among any Protozoa, certainly not among Mr. James-Clark's interesting forms of Flagellata, which he assimilates to ciliate sponges. It is the particular *kind* of individuality seen in sponges which removes them so far from their quondam associates, and demands consideration as to whether it is a plan of individualization peculiar to the group, and entitling them to a solitary position, or whether other organisms present the same features of structure. At the same time, be it remarked, we may look for forms connecting Sponges to some of the Protista; since the course of development has not improbably left some examples belonging to a stage of such an intermediate character. Supposing such forms to be recognized, they must not influence our judgment as to the significance of the high development of the more elaborately organized Sponges.

The probable result of Professor Häckel's arguments with most naturalists will be, in the first place, to cause them to admit the separation of Sponges from what are generally known as Protozoa. He will have greater difficulty in getting the association with Cœlenterata, and with Anthozoa in particular, admitted.

In preceding paragraphs it has been pointed out that the function of the mouth, cavity, and canal-system does not affect their homology or homogeny; and in the face of such forms as *Prosycum*, and the clearly demonstrable ectoderm and endoderm and antimera of some forms and the general community of plan which Sponges and Corals exhibit (as even Mr. Kent allows in assenting to *Protascus*), it is not possible to maintain that the canal-systems of sponges and Cœlenterata are two unrelated structures having no common genetic origin. The weight of evidence goes very much in favour of a common origin for the two sets of canals when impartially examined. The possibility of the two systems being nothing more than homoplastic has to be weighed in considering this matter. A greater mass of evidence will certainly be welcome in the way of clearing up doubt as to the possible independence of these two systems; but Professor Häckel's facts go a very long

way. The degree of intimacy in which Sponges are to be associated with Actinozoa, Hydrozoa, and Ctenophora is a question which Häckel does not attempt to decide as yet; and here Mr. Kent has unintentionally done the brilliant Professor of Jena an injustice. He does not definitely propose, as Mr. Kent represents, to group Sponges with Corals as *Thamnoda*, at the same time placing Hydromedusæ and Ctenophora in an equivalent group *Medusæ*; this he merely offers as a suggestion of the direction which affairs may have to take on account of the closer affinities of Sponges with Corals than with Hydroids*. He is more inclined at present to the separation of Cœlenterata into these two classes, Spongiæ and Acalephæ (or Cnidæ or Nematophora of Huxley), the latter including the Actinozoa, Hydrozoa, and Ctenophora—an excellent arrangement, which Häckel does not finally adopt because urticating cells are to be found in some worms and mollusks. The urticating cells of worms and mollusks, however, are by no means such remarkable and characteristic organs as those of Nematophora. Whilst it is desirable to associate sponges with the Cœlenterata, the fact that they *diverge* from a common stock must not be forgotten if we wish to exhibit their relations in a true genetic classification; and as yet, I venture to think, the two groups cannot be placed much nearer than within the limits of a large division: the higher Nematophora are not more closely "related in blood" to the Sponges than is *Aphrodite* to the Cestoids, or the Mammalia to *Amphioxus*, allowance being made in the comparison for the increased complexity of structure of the Worms and Vertebrates.

Professor P. J. Van Beneden of Louvain long since expressed very much the same opinion as to the nature of Sponges as that now advocated by Häckel, and previously to him by Leuckart—that is, so far as affinities with the Cœlenterata generally are concerned. Professor Van Beneden, in his work 'Zoologie médicale' (Paris, 1859, t. ii. p. 394), written in conjunction with Professor Gervais, said of the Sponge, "C'est l'animal du type polype réduit à sa plus simple expression."

* Through such a form as *Protohydra* it is more easy, if we only look to recent forms, to imagine a connexion between Sponges and Cœlenterates; but we must allow that in past time there have existed very simple Anthozoa also, which are not known to us now.

VII.—*On the Origin and Development of* Periphyllus testudo, *Van der Hoeven.* By C. Ritsema*.

In the sixth volume (for 1863) of the 'Nederlandsch Tijdschrift voor Entomologie,' Professor Jan van der Hoeven called attention to a small Hemipterous insect which frequently occurs on the leaves of *Acer campestre* and *A. pseudoplatanus*. He named it *Periphyllus testudo*.

It was observed in 1852 by J. Thornton, who gave it the name of *Phyllophorus testudinatus*, and regarded it as the pupa of a new species of *Aphis*, for which probably a new genus would have to be established†. Subsequently (1858) Lane Clarke mentioned the same little animal under the name of *Chelymorpha phyllophora*, and regarded it as the pupa of a form occupying a position between the genera *Aphis* and *Coccus*‡. These two writers, however, only give a short account of it. It was afterwards more fully described and also figured by Van der Hoeven as *Periphyllus testudo*§. This zoologist was of opinion that it belonged to the Hemiptera Homoptera; but he could not determine whether it would be better referred to the Aphididæ or to the Coccina, although he thought it was scarcely to be united with the former.

It was only in 1867 that something with regard to the origin of the animal in question was brought to light, when MM. Balbiani and Signoret presented to the French Academy of Sciences some communications upon it, which, under the title of "Note sur le Développement du Puceron brun de l'érable," were published in the 'Comptes Rendus' for the

* Translated from the Dutch by W. S. Dallas, F.L.S., from a separate impression communicated by the author, from the Mededeelingen der Kon. Akad. van Wetenschappen, 2de Reeks, Deel iv.

† Trans. Ent. Soc. London, 1852, n. s. vol. ii. Proc. p. 78.

‡ 'Objects for the Microscope, being a popular Description of the most instructive and beautiful subjects for exhibition,' by L. Lane Clarke. London, 1858. A second edition of this work was published in 1863.

§ As a reason for the rejection of the generic names which had been proposed by Thornton and Lane Clarke, Van der Hoeven states that both had been previously employed, *Phyllophora* having been made use of for genera of Crustacea, Coleoptera, Orthoptera, and Diptera; whilst a genus of Coleoptera had been established by Chevrolat under the name of *Chelymorpha* as early as 1834. I cannot, however, see clearly why Van der Hoeven changed the specific name of *testudinatus*, given by Thornton to this animal, into *testudo*, and I believe that there is no reason for so doing. But, as it will appear that in this case a larval form of a long-known and described insect has received a distinct name, which therefore must sink, I have thought it better to abstain from a strict application of the law of priority, and to adopt Van der Hoeven's name in this paper, than to increase still further the number of synonyms.

17th June in that year *. As the result of their investigation, they state that *Periphyllus testudo*, Van der Hoeven, of which neither a new genus nor even a new species is to be formed, is nothing more than an abnormal infertile form of *Aphis aceris*, Linn., and that this form is produced from individuals identical with those from which normal larvæ, capable of further development and of reproduction, originate; nay, they sometimes even ascertained that the same mother produced both forms.

Hence we can only regard the *Periphylli* as a constant variation from the specific type, produced by normal generations.

Bearing in mind the observations of Landois † concerning the law of sexual development of insects, from which we learn that in them the sexes simply depend upon the conditions of nutrition to which the larvæ have been subjected, the authors come to the conclusion that, although the abnormal plant-lice (*Periphylli*) are entirely destitute of the power of propagation, either by sexual reproduction or by any other means, we must not conclude that their conditions of nutrition might not subsequently be so modified that with the sexual characters they might acquire the power of unlimited direct propagation; so that these abnormal individuals would then in their turn become the origin of a new species, produced by variation from one specific type.

In the spring of 1868, whilst still unacquainted with the investigation just noticed, I had made some passing observations upon the same subject. The results of these investigations, continued and completed in 1869, will be stated in order in the following pages.

As early as the beginning of February, I observed upon a tree of *Acer pseudoplatanus* (Linn.) young larvæ of a species of plant-louse; and on closer examination of a small branch, I also found on the bark, especially in the axils and at the base of the buds, the glistening, black, oval eggs from which they had issued.

These larvæ were about 0·5 millim. in length, and of a dark green or nearly black colour. After changing their skins five times, they had become developed, at the end of March, into wingless nurses 3 millims. in length, strongly inflated and of a dark-green or brown colour, which quickly began to produce light-green larvæ; and these, in the latter half of April, after

* This memoir is translated into English in the 'Annals and Magazine of Natural History,' ser. 3. 1867, vol. xx. pp. 149–152, and is transferred from this without change, but with the addition of a figure of *Periphyllus testudo*, into Hardwick's 'Science Gossip' for Sept. of the same year.

† Comptes Rendus, February 4, 1867.

changing the skin only four times, attained their adult state. In this state some of them were winged, others wingless.

With the first generation, by means of Walker's "Descriptions of Aphides" (Ann. & Mag. Nat. Hist. ser. 2. vol. i. *et seqq.*), I had already determined the species to be *Aphis aceris* (Linn.); and this was confirmed by the comparison of the winged individuals of the second generation with Kaltenbach's and Koch's descriptions of this species.

After the nurses of the second generation had brought forth many young which perfectly agreed with the first life-phases of their mothers, I saw, in accordance with Balbiani's results, that individuals were born which I immediately recognized as *Periphyllus testudo*. The ordinary larvæ were further developed, and about the middle of May had become winged and wingless nurses, whilst the *Periphylli* had remained unaltered.

The third generation, again, in their turn gave birth at first to ordinary larvæ and afterwards to *Periphylli*, the latter even in greater number than had been produced by the second generation. I was now much surprised by finding among these larvæ examples which distinctly formed a transition between the two larval forms (the ordinary larvæ and the *Periphylli*), as in them the leaf-like appendages were fewer in number and more narrowly lanceolate, and, indeed, in some of them passed gradually into hairs. All these transitional forms were destitute of the regular figures which occur upon the back of the *Periphylli*, but possessed the two rows of setigerous tubercles and the two honey-tubes which we find on the dorsal surface of the ordinary larvæ, but which are wanting in the *Periphylli*. These individuals became further developed, and, after the first change of skin, were exactly like the ordinary larvæ.

The members of this fourth generation, except the *Periphylli*, had become perfect nurse-individuals in the latter part of May, and began to propagate as such, but not, as in the case of the two preceding generations, at first by ordinary larvæ and afterwards by *Periphylli*, but *vice versâ*, first by a number of *Periphylli*, then by a few transitional forms, and finally by a comparatively small number of ordinary larvæ.

These larvæ, however, died by a neglect on my part; so that I was unable to acquire certainty as to a conjecture which had occurred to me—namely, that the nurses of this fifth generation would propagate solely by *Periphylli*.

Nevertheless I did not omit to continue the careful observation of the *Periphylli* of different generations. Up to the end of August I could not detect even the smallest change in them. At that time, however, they became thicker in the body, and on both sides of the back some darker contents

began to show through the integument. After this, in the beginning of September, I found *Periphylli* changing their skins.

After this first moult they agreed exactly with the second life-phase of the ordinary larvæ, while a fortnight later they had attained their perfect state, in which they were all wingless. These nurses began immediately to propagate by light-yellow ordinary larvæ, which at the end of September changed their skin for the last time, and remained wingless like their mothers. The larvæ born from these nurses agreed very nearly with those of the preceding generation, and became developed before the middle of October into winged male and wingless female imagos, which quickly paired, after which the females attached about eight brownish-yellow eggs to the bark of the maple tree. These eggs slowly became black, and in the beginning of February 1870 will again furnish the first generation of *Aphis aceris* (Linn.).

Having reached the end of my memoir, I will briefly run over the results to which the investigation described has led.

In the first place, it is proved that *Periphyllus testudo* (V. d. Hoev.) is not a distinct species, but a peculiar larval form of *Aphis aceris*, occurring in the earliest period of its life.

In the second place, that this larval form is not, as has hitherto been supposed, incapable of further development, but that it is merely subjected to a long-continued cessation of development in its first stage, by which the multiplication of the above-mentioned species of *Aphis* is greatly limited.

In the third place, that it is produced only by the generations in which both winged and wingless individuals occur.

In the fourth place, that it is produced both from the winged and wingless nurses, in association with the ordinary larval form which undergoes a rapid development, and with individuals which form a sort of transition to the latter. And in the fifth place, that in the successive generations the *Periphylli* continually increase in number, whilst the number of the ordinary larvæ diminishes, and, indeed, to such a degree that the fourth generation (that is to say, the third from which *Periphylli* are born) only produces a few ordinary larvæ. From this I think we may conclude that nothing but *Periphylli* are produced from the fifth generation, which, in my case, unfortunately died. Should this actually prove to be the case, it would serve especially to prevent any very great increase of this species during the summer.

BIBLIOGRAPHICAL NOTICE.

Eminent Men of the Day. Photographed by G. C. Wallich, M.D. *Scientific Series.* London: Van Voorst, 1870.

We are pretty well accustomed, in our journeyings through some of the principal streets of London, to see photographic portraits of those scientific men whose names occupy the largest space in the estimation of the general public. Some of these "counterfeit presentments" are undoubtedly good; but others are deficient in those qualities of artistic effect which to a great extent constitute the charm of a portrait, whilst others are so badly managed in every respect that the distinguished originals must, we should think, experience a sad twinge when they catch a glimpse of likenesses which are little better than caricatures.

No such reproach can be laid upon Dr. Wallich, whose portraits of sixteen of our leading scientific men, now just published by Mr. Van Voorst, really leave little to be desired. All of them are nearly perfect likenesses; and to some the praise of actual perfection is due. All are vignetted and printed with a care which brings out the more delicate shades wonderfully, whilst Dr. Wallich's personal acquaintance with his sitters has enabled him, in most cases, to select the best positions for developing their characteristic expression.

The first volume of the 'Scientific Series,' now before us, including as it does the Presidents of nine of our principal societies, of course is by no means exclusively devoted to naturalists; nevertheless, if we regard geology as a branch of natural history, eleven of the sixteen portraits are those of men in whom naturalists generally must take an interest. Thus we have a most admirable and characteristic likeness of Professor Owen; an equally fine one of Mr. Bentham, the President of the Linnean Society; a likeness of Professor Huxley, in which that genially thoughtful expression familiar to his friends has been most happily reproduced; an excellent portrait of Dr. Hooker, perhaps the best in the book, and one of Lord Walden, which almost equals this. The portrait of General Sabine, who, as President of the Royal Society, may rank, *ex officio*, as a naturalist, is also remarkably characteristic, as are those of Sir Roderick Murchison, Sir Charles Lyell, Professor Ramsay, and Mr. Prestwich, and especially that of Professor Stokes, the Secretary of the Royal Society. The other portraits are those of Professor Tyndall, Sir William Logan, Director of the Geological Survey of Canada, Mr. Lassell, the President of the Royal Astronomical Society, the Rev. J. B. Reade, President of the Royal Microscopical Society, and Professor Williamson, President of the Chemical Society.

Artistically the best of these portraits are those of Mr. Bentham, Sir William Logan, and the Rev. J. B. Reade.

That we have referred specially above to the qualities of individual portraits is due rather to the desire of expressing the pleasure which we have felt personally in obtaining a series of such interesting pictures, than to any feeling that it was necessary to speak in terms of praise or blame of any particular one. When we have said

that all are very good and some admirable, there is little occasion for special criticism. We can only hope that the success of this elegant little volume may be such as to induce the artist and his publisher to continue their undertaking, and to furnish us in the same form with a complete series of these portraits, which will be of the highest value hereafter as illustrations to the history of science.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

April 28, 1870.—Dr. William Allen Miller, Treasurer and Vice-President, in the Chair.

"On the Organs of Vision in the Common Mole." By ROBERT JAMES LEE.

The eye of the Common Mole and the structures connected with it undergo some remarkable changes during the growth of the animal. The gentleman who does me the honour to present the results of an investigation into that subject to the Royal Society was desirous that it should be undertaken in order to ascertain the cause of the anomalous condition in which the organ of vision is found in the adult Mole.

It was the suggestion of Mr. Solly that an examination of the eye of the young or fœtal Mole might assist in the explanation; for Mr. Solly had reflected much on the subject, and entertained reasons for believing that such an inquiry would be attended with a satisfactory result.

It is known that there is distinct evidence of the existence of an eye and other parts concerned in the endowment of sight in many of the various species of the Mole genus. To what extent, however, the defective state of the organs permit of sight, or whether the animal is totally blind, are questions still undecided.

That the organs of vision in the young Mole would be found in a more perfect state than in mature age was what Mr. Solly anticipated, while he conjectured, for physiological reasons, that the cause of the difference between them would be found to be a process of atrophy or degeneration in the various structures essential for the enjoyment of sight.

The specimens sent me for the purpose of examination consisted of a female Mole, which appeared, from its dimensions, to have attained the full period of development, if it had not somewhat exceeded it, and of six unborn young about an inch and a quarter long, and, as far as I could judge, beyond the middle of the period of gestation.

Before entering into anatomical details, I venture to review briefly the researches which have been made by anatomists into this subject. A summary of the views entertained by those who preceded him is given by Gottfried Treviranus, in his work published in 1820, 'Vermischte Schriften, anatomischer und physiologischer Inhalt,' in the chapter on the Nerves of Sense in Mammalian Animals. From this account it appears that it was Zinn who first described an

optic nerve in the Mole, and declared it to be a branch of that division of the fifth pair of nerves which is distributed to the nose.

The description by Zinn was published in the fourth volume of the Commentaries of the Royal Society of Göttingen. "The optic nerve," he says, "is long and of considerable tenuity. Its origin is the same as that of the very large nerve which passes to the proboscis. It takes a long oblique course, lying above the muscles of the nose, and passing in an outward and backward direction, surrounded by dense structures, is finally inserted into the posterior part of the globe of the eye in the line of the axis of vision."

In 1813 Tiedemann published a description of the optic nerve and the fifth pair, which differed in a very important respect from the account given by Zinn; for he says that although the optic nerves are small and difficult to distinguish, yet they exist as separate nerves, and present the same general character as in most of the mammalia. Tiedemann carried his investigations still further, and declared the absence of the third, fourth, and sixth pairs of nerves. He described certain filaments, which he stated to be unconnected with the optic nerve, and to be similar to those branches which are found in the tissues around the eye in other animals. The absence of the third, fourth, and sixth pairs of nerves was subsequently asserted also by Carus; but his account of the origin and termination of the optic nerves is not quite intelligible to me. It appears, however, that the conclusions of Treviranus and Carus agreed that there was some connexion between the optic nerve and the fifth, which sufficed to supply the Mole to a certain degree with the sense of sight. Indeed the chief physiological fact which Treviranus endeavoured to establish in the chapter of the work alluded to, was that the nerves of one particular and special sense were capable, under certain circumstances, of becoming endowed with the properties of nerves of another and different sense. "The fifth pair of nerves in some mammalia supply the place of the most important nerve of sense," is the introductory sentence in the chapter; or, in other words, a nerve of touch and feeling may become a nerve of sight—that is, sensitive to the rays of light; and he concludes the chapter thus:—"I cannot but agree with Carus that the optic nerve and the fifth branch enter into connexion in the eye to produce the retina." This opinion met with opposition from Prof. Müller, who controverted it by the statement that true optic nerves had been exhibited to him by Dr. Henle (Baly's translation, p. 842).

From a remark of M. P. G. Pelletan, in his 'Mémoire sur la Spécialité des Nerfs des Sens,' quoted by Mr. Solly in his work on the Brain, it would appear that that anatomist had made a very careful examination of the organs of vision, both in the adult and fœtal Mole, for he "recommends the dissection of either fœtal Moles, or very young ones, in whom the optic foramen is still distinct." The importance of this remark consists in the proof that Pelletan had observed that the optic foramina undergo some change subsequent to the birth of the animal.

Von Siebold has published the results of investigations into the

difference between the eyes of certain species of *Talpa*. "The eyes are rudimentary," he says, "in the Mole and *Spalax typhlus*, which live underground; and above all in *Talpa cæca* and the Chrysochlores are the eyes rudimentary. They are a little more developed in the Shrews and the Common Mole. According to Ollivier (Bulletin de la Société Philomathique, vol. ii. No. 38, p. 105), all the ordinary elements of the eye are found in *Spalax typhlus*."

Leydig, in his 'Handbuch der Histologie,' has some important remarks on the eyes of blind animals, and has described, in Müller's 'Archives,' 1854, p. 346, the cellular structure of the lens of the Mole's eye, as presenting the character of embryonic structure, from which he concludes that the lens remains in its primitive embryonic condition.

Mr. Solly's investigations were directed to the state of the optic commissures at the base of the brain. "In the Mole," he says, "in which the optic nerves are so extremely minute that they have often escaped detection, and are by many authors described as entirely wanting, these commissural fibres are found distinctly crossing the base of the skull opposite the usual situation of the optic commissure; while the small black speck, evidently the rudiment of the eye, is supplied by a minute branch from the fifth pair" (p. 289, *op. cit.*).

In Prof. Owen's work on the 'Comparative Anatomy and Physiology of Vertebrates' (vol. iv. p. 246), the organ of sight, like that of smell, is stated to be "wanting in a few mammals, the eyeball being reduced to the size and condition of the ocellus in *Amblyopsis*, and to its simple primitive office of taking cognizance of light, a filament of the fifth aiding a remnant of the proper optic nerve. The Moles, especially the Italian kind, *Talpa cæca*, and Mole-rats, exemplify this condition, in which, as in *Spalax typhlus*, the skin passes over the ocellus without any palpebral opening or loss of hair."

Mr. Herbert Mayo has given a similar description in his 'Physiology,' and has supplemented it by a drawing, in which the fifth nerve is represented as sending a filament directly to the globe of the eye.

From the above enumeration of the views entertained by anatomists regarding the eye and optic nerve of the Mole, it is apparent that attention has been directed by some to the eye in particular, and to the structures intimately connected with it, while others have arrived at their conclusions from examination of the interior of the skull and the optic region of the brain.

It remained therefore to ascertain the condition of the optic nerve in the posterior part of the orbit, especially that portion of the nerve which lies in the optic foramen, and thus endeavour to connect the appearances described in the eye with those observed at the base of the brain.

It is proposed to give an account of the dissection of the full-grown Mole, in order to contrast the state of the eye, the optic nerve, and the cranium with that which those parts present in the fœtal Mole, following such an arrangement of the facts that the important points of difference shall be apparent without separate comparison.

The eye of the Common Mole presents the appearance of a minute black and shining bead, closely attached to the skin of the head, and concealed by the hair so completely that it is difficult sometimes to discover it. In removing the skin the small globe is easily detached at the same time, and no indication remains of the exact position in which it was situated. This shows that in the Mole the cavity of the orbit is wanting, and that the structures usually found in the vicinity of the eye are in a different condition from that which they present in other mammalia. It is necessary, therefore, to divide the skin around the base of the eye in order to preserve the connexion between the globe and the subjacent tissues.

Beneath the eye, and forming a basis on which it rests, is "a firm mass of cellular fibrous tissue which assumes on dissection a fusiform shape, with an attenuated portion passing towards the base of the skull." The filament becomes so exceedingly delicate in the deeper part of the orbit that the difficulty of ascertaining its precise condition is probably the reason of the difference of opinion on the subject.

In Mr. Solly's specimen there was found to be no attachment whatever of the filament to the base of the skull; but in a former dissection of a smaller, and probably younger specimen, the continuity between the bone and the tissue was evident.

The filament of tissue above described, and the connexion which it formed between the eye and the skull, induced me to examine it microscopically, in order to ascertain whether it contained nervous fibres, or possessed any of the characters of the optic nerve.

It exhibited a tendency to divide in a longitudinal direction when needles were applied to it, and presented the appearance of cellular tissue, without, however, any trace of nerve-fibre. It will be seen nevertheless, from the description of the optic nerve in the fœtal Mole, that this delicate thread is the only vestige which remains of that important part of the organs of vision in the full-grown Mole.

With regard to some minute branches of nerves and blood-vessels which pass into the tissue forming the base of the eye, both on its outer and inner side, it is not in my power to say definitely from whence they come, as their minute size prevented me from tracing them in the deeper part of the orbit to their points of exit from the skull.

The eye of the full-grown Mole presents a surface uniformly black and glistening, in which there is no indication of a cornea and sclerotic distinct from one another, nor any evidence of an iris or pupillary aperture. Within the globe, when ruptured with the points of needles, a layer of black pigmentary particles was found to line the internal surface of the dense structure which corresponds to the sclerotic.

In addition there was a confused mixture of grey and white granular substance, in which there was no distinct evidence of remains of the usual contents of the globe of the eye, though, as will be seen, those structures exist in fœtal life.

The specimens were sent to me preserved in alcohol, consequently the brain was firm, and easy to be removed entire from the cranium.

On raising the anterior lobes gently from the base of the skull, it was ascertained that no nerves connected the brain with the bone anterior to the fifth pair. The base of the brain also exhibited an entire absence of the optic nerves beyond a vestige in a very minute chiasma, as described by Mr. Solly.

On examining the internal surface of the base of the skull, the usual foramina for the optic nerves are found to be wanting, a condition which is observed with facility in the dried specimens in the Museum of the Royal College of Surgeons. Among these there is one in which there is a vestige of an optic foramen on the left side of the head, while on the opposite side the surface is smooth and perfect.

In the arrangement of the details which have been given above of the appearances observed in the course of the examination, attention has been directed to three points in particular, namely to the condition of that part of the optic nerve which is situated externally to the skull, and which exists as a mere thread of connective tissue; secondly, to the eye itself, and the structures within, so far as it was necessary to consider them in their efficiency for optical purposes; thirdly, to the internal surface of the skull in its relation to the part of the brain from which the optic nerves take their origin.

The following description of the various structures in the fœtal Mole will be more general than the above account of them in the full-grown Mole, as five specimens instead of one were examined.

On the removal of the skin and a layer of muscular tissue subjacent, a part of the globe of the eye is exposed. When the whole side of the face and the temporal region are dissected, the eye is found to be in close proximity to the large branch of the facial nerve.

The eye has the usual appearance presented by the organ in most fœtal mammalia; in form globular, and in size proportionate to the head of the animal; the cornea translucent; the sclerotic perfectly distinct, and of dense white tissue; the iris apparent through the cornea, with a clear pupillary aperture.

Between the eye and the facial nerve a small portion of the optic nerve is seen in the superficial dissection, and appears to form an upright peduncle for the globe.

It is necessary to divide the seventh pair in order to examine the deeper parts of the orbit. When the dissection is completed, and the optic nerve exposed in its whole extent, from the eye to the base of the cranium, the branches of the fifth pair of nerves are brought into view. The main branch of the second division of the fifth nerve lies a little below the optic nerve, parallel with it, and supplies large and numerous branches to the anterior part of the face. There is no necessity to describe minutely the appearance presented in the deep dissection of the orbit, as I observed nothing unusual to require particular notice. There are some minute muscles attached to the globe which do not admit of separation into distinct parts, but completely surround the posterior half of the globe.

To trace the optic nerve through its foramen to the brain was successfully accomplished in only one dissection. After exposing

the optic nerve and the eye completely, all the surrounding parts were removed, and a section made through the skull so as to exhibit a lateral view of the interior of the cranium.

The brain itself was disorganized in all the young specimens; but in the dissection just alluded to the optic nerve was seen to pass through the base of the skull, and to enter the membranes to a short distance, so that it would have been possible, if the brain had remained perfect, to trace it to its origin.

With regard to the eye itself, no difficulty was experienced in separating the iris, choroid, and lens. The other structures usually existing in the eye had been so long subjected to the influence of the alcohol that I could not determine their condition.

It must necessarily happen that many interesting observations are made in the course of an investigation like that which has been briefly described, and many minute details might have been added to this account; but it appeared to me to be desirable to limit the details, as far as possible, to those which were sufficient to establish the remarkable physiological fact that the Mole, at the time of birth, is endowed with organs of vision of considerable perfection, while in mature age it is deprived of the means of sight in consequence of certain changes which take place in the base of the skull, terminating in the destruction of the most important structures on which the enjoyment of the sense of sight depends.

May 5, 1870.—Lieut.-General Sir Edward Sabine, K.C.B., President, in the Chair.

The Bakerian Lecture was delivered by John W. Dawson, LL.D., F.R.S., &c., Principal and Vice-Chancellor of M'Gill College, Montreal, "On the Pre-Carboniferous Floras of North-Eastern America, with especial reference to that of the Erian (Devonian) Period." The following is an Abstract.

The attention of the author was first directed to the Devonian as distinguished from the Carboniferous flora by the discovery, on the part of Sir W. E. Logan, in 1843, of some remarkable remains of plants in the Sandstones of Gaspé, Canada. In 1859, after visiting Gaspé to study these plants *in situ*, the author published descriptions of them, and more particularly of the two characteristic Lower-Devonian genera *Prototaxites* and *Psilophyton*, in the Journal of the Geological Society.

Subsequently additional material was obtained by personal investigation of the Devonian of Maine and New Brunswick, and, through the kindness of Prof. James Hall, from that of New York. These additional plants were also published in the Journal of the Geological Society.

Still more recently, a thorough re-examination of the Gaspé beds, the systematic exploration of the plant-bearing beds near St. John by Prof. Hartt, and fresh collections made by Prof. Hall have enabled the author to prepare a catalogue of 121 species, and to attempt a thorough revision of the Erian flora, and an investigation of its conditions of growth and relations to the Carboniferous flora.

The term "Erian" is applied to the formations included between the top of the Upper Silurian and the base of the Carboniferous, on account of the uncertainties which have attended the subdivision and limitation of the Devonian of Europe, and also on account of the immense area occupied by these beds on the south and west of Lake Erie, and their admirable development with regard to subdivisions and fossils. The name "Erie Division" was also that originally applied to this typical series by the geologists of the Survey of New York.

A large part of the paper was occupied with the revision of the Erian flora, including the description of twenty-three new species, and more ample descriptions of others previously known only in fragments. Large trunks of *Prototaxites*, from the base of the Lower Devonian, were described, and full details given of the form, structure, and fructification of two species of *Psilophyton*. The new genus *Ormoxylon* was described. The genus *Cyclostigma* was noticed, as represented by two species in America, and its foliage and fruit described for the first time. The genera of the Erian Ferns were examined and corrected, and several interesting trunks and stipes belonging to Tree-ferns were described. The fruits of the genus *Cardiocarpum* were illustrated with reference to their structure. The occurrence of *Lepidophloios, Calamodendron*, and other forms in the Middle Devonian was noticed for the first time.

The third part of the memoir was occupied with comparisons and general conclusions. At the close of the Upper-Silurian period there was a great subsidence of the land in Eastern America, proved by the wide extent of the marine beds of the Lower Helderberg (Ludlow) group. It was on the small areas of Lower-Silurian and Laurentian land remaining after this subsidence that the oldest land plants known in the region flourished. Re-elevation occurred early in the Devonian period, and the known flora receives considerable extension in the shallow-water beds of the Lower Erian. The subsidence indicated by the great Corniferous limestone interrupted these conditions on the west side of the Appalachians, but not on their eastern side. At the close of this we find the rich Middle-Devonian flora, which diminishes toward the close of the period; and, after the physical disturbances which on the east side of the Appalachians terminated the Erian age, it is followed by the meagre and quite dissimilar flora of the Lower Carboniferous; and this, after the subsidence indicated by the Carboniferous limestone, is followed by the Coal-formation flora.

If we compare the Erian and Carboniferous floras, we find that the leading genera of the latter are represented in the former (but, for the most part, under distinct specific forms), that the Erian possesses some genera of its own, and that many Carboniferous genera have not yet been recognized in the Erian. There is also great local diversity in the Erian flora, conveying the impression that the conditions affecting the growth of plants were more varied, and the facilities for migration of species less extensive, than in the Carboniferous.

In comparing the Erian flora of America with the Devonian of

Europe, we meet with the difficulty that little is known of the plants of the Lower and Middle Devonian in Europe. There are, however, specimens in the Museum of the Geological Survey which show, in connexion with facts which can be gleaned from the works of continental writers, that *Psilophyton* occupied the same important place in Europe which it did in America; and in the Upper Devonian the generic forms are very similar, though the species are, for the most part, different.

In Eastern America no land flora is known below the Upper Silurian; and even in that series the plants found are confined to the genus *Psilophyton*. Independently, however, of the somewhat doubtful Lower-Silurian plants stated to have been found in Europe, there are indications, in the Lower-Erian flora, that it must have been the successor of a Silurian flora as yet almost unknown to us; and the line of separation between this old flora and that of the Devonian proper seems to be at the base of the Middle Devonian.

In applying these facts and considerations to the questions relating to the introduction and extinction of species, and the actual relations of successive floras, it was proposed to compare what might be called specific types,—that is, forms which in any given period could not be rationally supposed to be genetically related. Of such specific types, at least fifty may be reckoned in the Erian flora; of these, only three or four are represented in the Carboniferous by identical species, while about one half are represented by allied species. The remainder have no representatives.

A Table of specific types of the Erian was given, and its bearing shown on the questions above referred to; and the hope was expressed that by separating such types from doubtful species and varietal forms, some progress might be made towards understanding, at least, the times and conditions in which specific types were introduced and perished, and the range of varietal forms through which they passed.

MISCELLANEOUS.

Observations on some Indian and Malayan Amphibia and Reptilia. By Dr. F. Stoliczka. (Abstract.)

The species described in this paper have been partially collected by the author along the Burmese and Malayan coast, in Penang, and Singapore, partially at the Nicobar and Andaman islands; only a few species are noticed from Java, and a few also from the N.W. Himalayas. Short notes on the geographical distribution, and on the general character of the amphibian and reptilian fauna of the Andamans and Nicobars, form a brief preface to the detailed descriptions. Complete lists of all the known species occurring on the two last-named groups of islands are appended.

The following is a list of the species noticed, with the localities wherefrom specimens have been obtained, and brief characteristics of the new species.

AMPHIBIA.

Batrachia.

1. *Rana gracilis*, Wiegm. (typical). Sundarbans, Arracan, Rangoon, Moulmein, Penang, Wellesley Province, &c.

Rana gracilis, var. *andamanensis*. Andamans.

—— ——, var. *nicobariensis*. Nicobars.

—— ——, var. *pulla*. Penang hill.

2. *Rana cyanophlictis*, Schneid. Orissa.

3. *Pyxicephalus breviceps*, Schneid. From near Kotegurh.

4. *Polypedates Hascheanus*, n. sp. A small species from the forests of Penang hill. Distance between anus and heel slightly less than the length of the body; brown, lighter or darker; a blackish band between the eyes, a W-mark between the shoulders, a pair of blackish spots about the middle of the body; limbs with dark cross bands: body of largest specimen $\frac{15}{16}$ inch long.

5. *Polyp. maculatus*, Gray. Penang.

6. *Hylorana Tytleri*, Theob. (?? =*erythræa*, Schleg.). Moulmein.

7. *Hylorana nicobariensis*, n. sp. From the Nicobars. Allied to *H. temporalis* of Günther, but has two small glandular tubercles behind the angle of the mouth; distance between anus and heel less than the length of the body, fourth toe less than its half.

Ansonia, n. gen. (*Rhinodermatidæ*). Body slender, limbs long and slender, fingers free, toes half-webbed, disks scarcely swollen; muzzle short, canthus rostralis sharp; no teeth; tongue entire, oval, elongated.

8. *A. penangensis*. Found on rocks in streams on Penang hill. Full-grown specimen $\frac{14}{16}$ inch, hind limb $1\frac{5}{16}$ inch; body tubercular, black with pale yellowish-white spots on the side, and purplish-red below, between the limbs and on the lower belly.

9. *Diplopelma carnaticum*, Jerdon.

10. *Caloula pulchra*, Gray. From Moulmein.

11. *Bufo viridis*, Laur. From the Sutlej valley.

12. *Bufo melanostictus*, Schneid. From Bengal, Burma, Malay peninsula, Andamans, and Nicobars.

REPTILIA.

Lacertilia.

13. *Ptychozoon homalocephalum*, Kuhl. Nicobars.

14. *Gecko guttatus*, Daud. Burma and Andamans.

15. —— *stentor*, Cant. Andamans.

16. —— *Smithii*, Gray. Java.

17. *Phelsuma andamanense*, Blyth. Andamans.

18. *Peripia Peronii*, Cant. Penang.

19. —— *Cantoris*, Günth. Andamans.

20. *Hemidactylus frenatus*, Schleg. Burma, Penang, Andamans, and Nicobars.

21. *Hemidactylus maculatus*, D. & B. Moulmein, Andamans, Calcutta, &c.

22. *Cyrtodactylus rubidus* (*Puellula rubida*, Blyth). Andamans.

23. —— *affinis*, n. sp. Penang. Like *Gymnodactylus pulchellus*, Gray, in form and coloration, but with longer fingers and toes, and apparently more depressed body, no enlarged chin-shields or subcaudals, and no femoral pores.

24. *Tiliqua carinata*, Schneid. (*Eup. rufescens* apud Günth.). Bengal, Burma, Penang, Andamans, &c.

25. *Tiliqua olivacea*, Gray, Nicobars.

26. —— *rugifera*, n. sp. Nicobars. Each scale five-keeled; scales in 26 series round the body, 23 transverse rows between the limbs, 8 longitudinal rows on the belly; brown above, two pale streaks on the anterior half of the body, pale yellowish or greenish-white below.

27. *Mabouya Jerdoniana*, n. sp. Penang. Like *M. agilis*, Gray, but it has 7 supraciliaries, 8 upper labials, scales in 39 series round the body, 60 transverse rows between the limbs; preanals scarcely, subcaudals distinctly enlarged.

28. *Hinulia maculata*, Blyth. Martaban.

29. *Riopa lineolata*, n. sp. Martaban. Similar to *R. Bowringii*, Günth., and equal to it in size, but with scales in 24 longitudinal series round the body, and 60–65 transverse series between the limbs.

30. *Calotes mystaceus*, D. & B. Arracan, Bassein, Moulmein, &c.

31. *Bronchocele cristatella*, Kuhl. Penang.

32. —— *moluccana*, Less. Singapore.

33. —— *jubata*, D. & B. Java, Nicobars.

34. *Tiaris subcristata*, Blyth (*Coryphylax Maximiliani*, Fitz.). Andamans and Nicobars.

35. *Draco volans*, L. Penang.

Ophidia.

36. *Cylindrophis rufus*, Laur. Upper Burma.

37. *Ablabes melanocephalus*, Gray. Singapore.

38. —— *Rappii*, Günth. Simla.

39. —— *collaris*, Gray. Simla.

40. —— *nicobariensis*, n. sp. Nicobars. Scales smooth, in 17 series, ventrals 189, anal bifid, subcaudals 87; in coloration similar to *melanocephalus*, but the lateral spots are smaller and much more numerous: length 17½ inches, of which that of the tail is 4¼ inches.

41. *Ptyas mucosus*, L. N.W. Himalaya, Moulmein, Andamans.

42. —— *hexagonotus*, Cant. (*Xenelaphis* idem apud Günth.). Penang.

43. *Compsosoma radiatum*, Rein. Moulmein.

44. —— *melanurum*, Schleg. Andamans.

45. —— *semifasciata* (*Platyceps* idem), Blyth. South of Simla.

46. —— *Hodgsonii*, Günth. N.E. of Simla.

47. *Tropidonotus quincunciatus*, Schleg. (*Trop. Tytleri* and *striolatus*, Blyth). Burma, Andamans.

48. *Trop. stolatus*, L. Moulmein, Amherst.

49. —— *platyceps*, Blyth (*Zamenis himalayanus*, Steindachner). Kulu.

50. *Gonyosoma oxycephalum*, Boie. Andamans.
51. *Dendrophis picta*, Gmel. Burma, Andamans, Nicobars, Penang.
52. —— *caudolineata*, Gray. Penang.
53. *Chrysopelea ornata*, Shaw. Penang, Burma.
54. —— *rubescens*, Gray. Penang.
55. *Psammophis condanurus*, Merr. (*Phayrea isabellina*, Theob.). Simla.
56. *Tragops fronticinctus*, Günth. Amherst.
57. *Dipsas hexagonotus*, Blyth. Andamans.
58. —— *multifasciata*, Blyth. South of Simla.
59. *Lycodon striatus*, Shaw. From near Kotegurh.
60. —— *aulicus*, L. (*Tytleria hypsirhinoides*, Theobald). Andamans and India generally.
61. *Tetragonosoma effrene*, Cant., var. Banca.
62. *Python molurus*, Linn. Upper Burma, Malayan peninsula.
63. —— *reticulatus*, Schneid. Nicobars.
64. *Hypsirrhina plumbea*, Boie. Upper Burma.
65. *Cerberus rhynchops*, Schneid. Burma, Andamans, Nicobars, &c.
66. *Hipistes hydrinus*, Cant. Amherst.
67. *Cantoria Dayana*, n. sp. Amherst. Form typical, scales in 19 series, ventrals 268, anal bifid, subcaudals 56; dull bluish black, with numerous yellowish cross bands, narrow on the back but widening laterally.
68. *Bangurus cæruleus*, Schneid. Bassein.
69. *Ophiophagus elaps*, Schleg. Burma, Andamans.
70. *Naja tripudians*, Merr. N.W. Himalaya, Andamans.
71. *Callophis intestinalis*, Laur. Upper Burma.
72. *Enhydrina valakadyn*, Boie (*E. bengalensis*, Gray). Orissa.
73. —— *schistosa*, Daud. Gopalpore.
74. *Pelamis platurus*, L. (*P. bicolor*, Schneid.). Bay of Bengal.
75. *Trimeresurus gramineus*, Shaw. Khasi hills.
76. —— *erythrurus*, Cant. Burma, Java.
77. —— *carinatus*, Gray. N.W. Himalaya.
78. —— *porphyraceus*, Blyth. Andamans.
79. —— *mutabilis*, n. sp. Andamans and Nicobars. Scales in 21 series, ventrals 156–167, subcaudals 48–62; second labial forms the angle of the facial pit, or is divided into two shields; colour uniform reddish-brown, or with numerous greenish-white cross bands on the back, laterally with longitudinal bands.
80. *Trimeresurus Cantori*, Blyth. Andamans and Nicobars.
81. —— *convictus*, n. sp. Penang. Like *T. monticola*, Günth., but with much larger scales, which are disposed in 21 series; ventrals 132, subcaudals 29.
82. *Halys himalayanus*, Günth. N.W. Himalaya.
83. *Daboia Russelli*, Shaw. N.W. Himalaya.

CHELONIA.

84. *Emys crassicollis*, Bell. Penang.

Dr. Stoliczka gave a short sketch of the relations existing between the Andaman and Nicobar reptilian fauna and that of Burma on one hand, and of Java, Sumatra, and the Philippine Islands on the other hand. All these islands, &c., he said, have many species in common. He also specially noticed the very great number of viperine snakes (*Trimeresurus*) which are to be met with at the Nicobars; but fortunately these species appear to be less dangerous than continental forms usually are. The Nicobarese say that not a single fatal case results from the bite of these *Trimeresuri*; and certainly all the specimens examined had a comparatively small poison-gland. The result of the bite is said to be only a swelling of the wounded part. Dr. Stoliczka also exhibited a specimen of the rare *Callophis intestinalis* obtained from Upper Burma. The species has the poison-glands extending from the head to about $\frac{1}{3}$ of the total length of the body, lying free in the cavity of the anterior part, and causing the heart to be much further removed backward than is generally the case in other species of snakes.—*From the Proceedings of the Asiatic Society of Bengal for* April 1870.

On the Organization and Embryogeny of the Ascidia.—*Development of* Molgula tubulosa. By M. Lacaze-Duthiers.

There are few zoological discoveries which have more vividly and justly excited the interest of naturalists than that of the metamorphoses of the Ascidians. Savigny, in studying the organization of these animals, found some little bodies "among the ova disseminated between the tunic and the branchial sac, which appeared to be fœtuses." If the drawings which he gave prove that he knew the larval form of these animals, it is nevertheless certain that the true significance of these little bodies was not really incontestably proved until after M. Milne-Edwards's researches.

The subsequent observations of MM. Kölliker, Van Beneden, Kowalewski, Küpffer, and of many other naturalists have only confirmed the remarkable observations of the French zoologist; and now-a-days everybody admits that all the *Ascidians, when young, at their escape from the egg, have a larval form which makes them comparable, in appearance alone, with the tadpoles of the frogs.* This hitherto has been an opinion not only undisputed, but apparently indisputable.

The anatomy of *Molgula*, one of the most interesting types of the group of simple Ascidians, has occupied me during nearly two summers. In studying its development, I wished to compare the morphological data furnished by the observation of the adult with those revealed by the successive appearance of the organs.

To make more certain of my results by multiplying comparisons, I commenced by observing the embryos of some *Phallusiæ* of the coasts of the Channel, the study of which appeared to me to be comparatively easier; and it is by means of artificial fecundations that I have been able to follow the various transformations of the ovum, commencing with its segmentation, which is appreciable only

by the employment of this experimental process; for the ovum of the Ascidians is surrounded, outside its vitelline membrane, by a cellular envelope, the elements of which may be mistaken (as indeed has been done) for cells of the mulberry-like mass which is the result of segmentation. But when we first of all study the development of the ovum within the genital gland, from its origin to its maturity, and when we then, after the action of the spermatozoid, see the vitellus divide and subdivide beneath the cells of the external envelope, we can no longer have any doubt as to the nature of the parts.

The results of artificial fecundations are easily obtained; and with their aid we may with certainty trace, starting from the segmentation, the appearance of the first form of the embryo, its exclusion, and the transformations which lead up to the perfect animal.

There is not a naturalist who has observed the embryos of the Ascidians and has not expressed the astonishment produced in him by the sight of these tadpoles, so active at first, and finally getting rid of their tail or locomotive organ, fixing themselves and becoming sedentary.

Now, from this point of view, *Molgula* presents a very remarkable exception. Long before hatching, the tadpole-like embryo of the *Phallusiæ* moves within the shell which encloses it, and turns about with jerking movements. The embryo of *Molgula*, on the contrary, moves slowly, and its movements are but slightly perceptible beneath the cellular envelope which covers it. Nevertheless its movements produce variations in its general form, which lead to the rupture of the capsule of the egg at a point which has become culminant, and through which it issues like an *Amœba*, *by flowing* like a rounded, plastic, fluid, pasty mass, destitute of a tail, and remaining sedentary at the bottom of the vessel.

Many times I repeated this observation in the fear that I might have taken abnormally formed embryos for properly constructed individuals; and the results were always the same.

From this time, therefore, it is ascertained that *the body of the young* Molgula *is supple and contractile, modifies its form slowly by amœboid movements, but never enjoys that agility or activity which is so remarkable in the first movements of the life of the other Ascidians whose embryogeny has been studied.*

Almost immediately after exclusion, the young *Molgula* presents, in its globular body, zones, the different nature of which is shown by different tints. One of these, the outermost, produces some processes, which are limited to the number of five for a considerable time, and which may be seen, so to speak, to shoot forth under our eyes. They serve to attach the embryo to the bodies which surround it, and are evidently the analogues of the innumerable filaments of the tunic of the adult, the extremities of which, by retaining grains of sand, form the characteristic covering of the animal.

I have hatched very numerous embryos from both artificial and natural fecundations, and seen them quickly attach themselves. The ease with which they may be kept alive enabled me to follow

the same individuals for more than two months, and to see the organs form and the young *Molgula* become completed.

In this abstract it would be difficult to give any details with regard to the transformations of the tissues and the formation of the organs. I desire particularly to call the attention of naturalists to an exception which is equally remarkable and little known, but which relates to the existence of one of the characters of the class; regarded by all zoologists as one of the most certainly established. A fact so unexpected must show what reserve and prudence should always guide us in zoological generalizations. No doubt there was no induction more legitimate than that which ascribed to all the Ascidians a tadpole-like embryo; and yet the *Molgulæ* do not fall under this general rule.

In this remarkable exception we also certainly find a fresh example in support of the principle that, in order to arrive with certainty at the knowledge of characters, we require the concurrence of all morphological as well as of all embryogenic data; for although embryogeny may and must furnish valuable information, by itself it may also, in some cases, lead us into the gravest errors. Of this, *Molgula*, by the exceptional form of its larva, furnishes a proof.—*Comptes Rendus*, May 30, 1870, tome lxx. p. 1154.

On the Embryonal Development of Bothriocephalus proboscideus. By E. Mecznikow.

Kölliker has already remarked that in *Bothriocephalus proboscideus* only part of the contents of the ovum is employed in the formation of the embryo, and that the remainder forms a layer of peripheral cells, the fate of which was unknown to him. M. Knoch has recently questioned the accuracy of this observation, but, it appears, erroneously. Mecznikow describes the ova of this cestoid worm as occupied by an ovarian cell surrounded by a mass of granular vitellus. The cell undergoes complete segmentation, whilst the vitelline mass takes no part in the formation of the embryo. From the cellular mass produced by segmentation, two cells, furnished with larger nuclei than the rest, soon separate; they fix themselves at the two poles of the ovum, and do not disappear until the close of embryonic life. The author has seen a perfectly similar arrangement in the ova of *Tænia cucumerina*.

After segmentation the mass of embryonal cells acquires a rounded form; and the embryo divides into a central nucleus and a peripheral mass formed of very evident cells. Whilst the nucleus forms the true larva of the cestoid worm with its hooklets, the layer of peripheral cells becomes connected into a delicate membrane, which finally loses its cellular structure, and acquires the appearance of a homogeneous cuticular envelope.

Although this envelope of the embryo never becomes covered with vibratile cilia, Mecznikow does not hesitate to compare it to the ciliated envelope of the larva of *Bothriocephalus latus*. This com-

parison is interesting. In fact the development of *Bothriocephalus proboscideus* shows that the embryonal envelope is the homologue of the amnios of the embryos of insects and other Arthropoda. In this case the ciliated envelope of the larva of *Bothriocephalus latus* would be a sort of amnios persisting for a long time after exclusion. But then we must extend this homology to the ciliated envelope of the embryos of the Monostomata and of M. Desor's Nemertean. To be consistent, indeed, we must regard the pilidium as a sort of provisional envelope of its *Nemertes*—as an amnios which acquires a remarkable degree of independence.—*Mélanges Biologiques tirés du Bull. Acad. Imp. des Sciences de St. Pétersb.* tome vi. p. 717; *Bibl. Univ.* tome xxxvii. Jan. 15, 1870, *Bull. Sci.* p. 87.

On the Buenos-Ayres Finner. By Dr. Burmeister.

(In a letter to Dr. J. E. Gray.)

I have received another Whale, well preserved and entire, of which I have made a careful drawing, which I intend to publish as soon as the skeleton is cleaned and transported to the Museum. At present I am not quite certain of the identity of the animal; but I believe it is *Physalus patachonicus.* The body is sixty feet long, six feet high, and sixteen feet in circumference; it is a male. The complete specimen which I described three years ago was a female, so that now I shall have both sexes of the species. Unfortunately putrefaction had begun and I was unable to preserve or examine anything of the intestines. As the body is deposited on the shores of the river nearly two miles from Buenos Ayres, it is somewhat difficult for me to study it in detail; so that I shall only be able to present to the scientific public a drawing of the entire animal and its skeleton, which I shall send to you, to have published in London.

New Localities for Zonites glaber.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,

In your May number of the 'Annals,' Mr. Jeffreys describes a new British land-shell, *Zonites glaber.* It may be interesting to many of your readers to know a few other localities whence I have obtained it:—In 1862 from near Leeds; in 1864 my son took it in Guernsey; in 1868 I took it at Bristol; same year near London; in 1869 from Jersey.

I remain, Gentlemen,
Yours, &c.
W. Rich.

14 Great Russell Street, Bloomsbury.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 32. AUGUST 1870.

VIII.—*On the Use of the Term "Homology."* By St. George Mivart, F.R.S.

Anatomical science in this country will ever be very deeply indebted to the efforts made by Professor Owen, a quarter of a century ago, to familiarize the English mind with what was called "philosophical anatomy" and to elaborate a self-consistent theory of the vertebrate skeleton.

Whatever opinions may be entertained as to the success of the latter endeavour, all must admit that it has been the occasion of an important scientific advance, through the efforts induced to support, or to modify, or to refute the system and the ideas which he brought forward.

And more than this may be said as to the permanence of good results; for much as G. St.-Hilaire and Cuvier contended together in France, so in England two schools have sought for the separate and exclusive establishment of views really capable of a fruitful and harmonious coexistence.

This reconciliation displays itself more and more. At one time Professor Owen's views as to "ideal archetypes" and his notions respecting the vertebral composition of the skull were objected to, not as erroneous in detail, but as fundamentally baseless. Then came Mr. Darwin's "natural selection" to give, as some thought, the "*coup de grâce*" to such fancies; and finally appeared "pangenesis" to slay the slain and to make fortuitous compounds of atoms occupy the vacant thrones of the deposed divine prototypal ideas.

Nor did these latter seem to many to fall alone. Teleology had been a favourite subject with Professor Owen; and with teleology evolution appeared to wage battle *à outrance*. It was not that this or that application was disputed; but the whole conception fell into utter disesteem, and the purpose-

lessness of the organic world became with some almost a dogma of faith.

Time, however, has again brought about a change in the situation. From the same professorial chair whence Professor Owen, in 1849, propagated his views, Professor Huxley, in 1869, gave out in turn a quasi-vertebral theory of the skull; and the same Professor, in the first number of the 'Academy,' has eloquently proclaimed, not only the complete compatibility of "teleology" with "evolutionism," but even the utter impotence of the latter to weaken in however small a degree the position of the teleologist.

The impulse given so long ago is yet far from being exhausted; and the latest manifestation of it is the interesting paper on homology by Mr. E. Ray Lankester, which appeared in the last number of the 'Annals.'

In that paper Mr. Lankester proposed to suppress the old term "homology," which has done such signal service, and to substitute for it two others, which are well chosen and will probably be useful.

Before noticing them, however, I must protest, *in limine*, against the notion (which Mr. Lankester seems to favour) that the acceptance of the theory of evolution, even of the special Darwinian form of it, is any bar to the reception of that view which represents all organic forms as having been created according to certain fixed ideal types. The two beliefs, far from being reciprocally exclusive, can and do coexist in perfect harmony in one and the same individual mind.

As to the proposal to abandon the term "homology," I, for one, should very much regret that dereliction, which would be, I think, prejudicial to science.

Amongst the valuable results of Professor Owen's long labours may be mentioned the many happy terms devised by him, and his suggestions as to the formation of a convenient anatomical nomenclature.

Amongst these terms, as Mr. Lankester remarks, are homology, homological, homologue, and analogy, analogical, analogue,—the first three terms referring to close resemblances between parts depending on relations of relative position, the other three depending only on functional similarity.

For the abandoned word "homology," Mr. Lankester would substitute "homogeny" and "homoplasy." The former of these refers to parts the resemblances between which are due to close genetic relations; the latter includes "all cases of close resemblance of form which are not traceable to homogeny, and all *details* of agreement not homogenous, in struc-

tures which are broadly homogenous as well as in structures having no genetic affinity." Mr. Lankester would retain the words "analogy" and "analogous" in Professor Owen's sense, *i. e.* for parts functionally similar, whether homologous or not; and thus we have three generic terms for relations of parts one to another, which may be either analogous, or homogenous, or homoplastic; they may also be at the same time both analogous and homogenous, or analogous and homoplastic.

I cordially agree as to the desirability of the retention of the term "analogy" in the sense mentioned; but I contend that it is desirable to retain the word "homology" also, and that in the very sense Professor Owen gave to it—namely, a close resemblance of parts as regards their relation to surrounding parts, to whatever cause that resemblance may be due, whether genetic or otherwise.

Mr. Lankester's terms will be useful additions to be employed when it is possible to determine to which process any given resemblance is due, *i. e.* whether it is a homogenetic or a homoplastic homology.

In this way we shall have parts divisible into two categories, viz.: 1. Analogues; 2. Homologues. The latter will be further divisible, and "homology" will be, as it were, a generic term, with homogeny and homoplasy as two species under it.

I advocate this arrangement for three reasons:—

1. Because it is not possible always to discriminate between homogeny and homoplasy.

2. Because there is more than one kind of homogeny; so that if the word "homology" be abandoned, two terms will not be enough to replace it.

3. Because instead of there being three relations tolerably equivalent in value expressed by the terms analogy, homogeny, and homoplasy, homogeny and homoplasy are very much more closely related than is either of these two with analogy,—the two latter terms both referring to relations of position and having nothing to do with the action of the parts named, the first term, on the other hand, referring to function exclusively.

In the first place, it is not necessary to do more than refer to the great number of cases where at present it is impossible to say whether, on the theory of evolution, certain parts should be called homogens or homoplasts. I quite agree with Mr. Lankester that "valuable results may be obtained from an investigation of the numerous problems of homology by the light which the discrimination of homogenous and homoplastic formations can afford" (how fruitful have been the investigations as to the vertebral structure of the skull!); but I, indeed,

agree with him in thinking that this discrimination will be "a matter of time and labour." In the meantime, therefore, it will be useful to speak of such undetermined parts simply as "*homologues*."

In the second place we have two kinds of homogeny:—one, such as the evolutionary homogeny between the tarsus of *Galago* and that of *Cheirogaleus*, and which may be called *ancestral* homogeny; the other, such as the homogeny of parts which go through a process of development which is similar in the two individuals to which the parts compared belong, as the homogeny between the mammalian incus and the os quadratum of a bird; this may perhaps be termed *developmental* homogeny.

It is quite possible to have, on the one hand, developmental homogeny between parts which are not ancestrally* homogenous, and, on the other, to have ancestral homogeny between parts which are not developmentally homogenous.

Thus (on Mr. Lankester's showing, and simply accepting his illustrations) the cranial bones of man are developmentally, not ancestrally, homogenous with their homologues in an osseous fish. On the other hand, the six legs of one fly must, by every evolutionist, be considered ancestrally homogenous with those of another; and yet the legs of such as are formed from "imaginal disks" cannot be said to be developmentally homogenous with the legs of such Diptera as are not so formed.

That developmental homogeny is important, can hardly be denied, seeing that the great argument for the homology of any two parts has been generally held to be the fact of their undergoing the same process of development. Now it is inconvenient not to be able to indicate both kinds of homogeny and homoplasy by a common term; and therefore I think it better to preserve the word "homology."

Thirdly, I think it better to regard homoplasy as a species under homology, because the affinity between homoplasts and homogens is so much greater than between homoplasts and analogues, even sometimes when the latter are to a certain degree homogenetic.

Thus there is, I think, little doubt that Mammals and Cephalopods have been perfected independently, while the Cephalopods and other mollusks have a closer affinity. Yet the resemblance between the homoplastic eyes of a seal and a cuttlefish more closely corresponds with the resemblance be-

* Of course I mean not *directly* homogenous ancestrally, *i. e.* independently originated in structures which may or may not be homogens of a more remote and general kind.

tween the homogenetic eyes of a seal and a monkey, than the same resemblance (*i. e.* that between the eyes of the seal and cuttlefish) corresponds with the resemblance between the analogous visual organs of the cuttlefish and scallop, in spite of the probably nearer genetic affinity between the two latter animals.

Indeed the distinction between homogeny and homoplasy is reduced to a subordinate position through the wonderful way in which the latter simulates, as it were, the former. The degree to which homoplasy can rival homogeny in the completeness of the homology produced is most striking, especially if we may consider it certain that the cranial bones of mammals and of osseous fishes are merely homoplastic homologues. I cannot agree with Mr. Lankester in thinking that "the room for diversity is not very great" on a probably homogenetic basis: and if there *is* room for diversity, then the concordance is most remarkable; for the homologies are so conspicuous as, in many cases, to be hardly disputable; and the result is, that the question as to *the mode in which* such homologies arose, though always a very interesting inquiry, becomes, as has been said, of subordinate importance.

As to the difference in the mode in which certain bones are developed in different animals, it tells, I think, in support of the view here advocated. It surely cannot be thoroughly and consistently maintained that the same bones are always developed in exactly the same way—to wit, that the clavicle formed from cartilage and the clavicle formed from membrane are two different bones! and if a diversity as to mode of origin is once admitted, where is the line then to be drawn? Far from thinking that the occasional representation of cartilage-bones by bones formed from membrane is an argument against recognizing the homology of such diversely arising bones, I have long maintained that such homologies are good arguments against the laying of so great a stress upon the mode of ossification as has of late been done.

In the same way it does not seem unreasonable to regard the auricles and ventricles of birds as homologous with the auricles and ventricles of mammals, in spite of the diversity in their mode of origin. Although the homology will be a homoplastic one, yet it will be an homology—the parts having a very close resemblance, in their relations to surrounding structures, in both birds and mammals. On the other hand, between these cavities and the chambers of the heart of a Myriopod there is but a certain relation of analogy.

With regard to the question, What here is "covered by the term homology over and above homogeny?" in this case (as also in the relationship of certain homologous muscles in

birds and mammals) it may be replied that it is a complex correspondence between parts as to their relative positions, according to a certain line of thought, and independently of their mode of origin; in other words, conformity to type. This answer will, I know, be distasteful to some; but I contend that it is a very rational answer for all that. It is true that types have none but an ideal existence, that types, *as types*, are not real, objective entities; but that is no more reason for refusing to recognize their ideal existence and their objective realization in individuals than is the non-existence objectively of species, *as species*, a reason for refusing to recognize their individual realization or to make use of zoological specific names.

An intellect of a higher order than that of man would probably detect an indefinite number of relations between two animals and between their component parts, which relations escape us altogether. As it is, we can detect a certain number of relations of function, of origin, and of conformity of relative position of different kinds according to the different ways in which we regard the subject matter, *i. e.* as we follow up different lines of thought. It is well to have distinct names for at least the more obviously different conceptions of this kind, about a quarter of a hundred of which may be readily distinguished.

Mr. Lankester proposes to use the word "*homotrophy*" to denote that kind of homoplasy which is due to causes at work other and "besides an agreement in environment or external evoking conditions."

I would suggest the term "*actinology*" to denote that kind of homological relation which exists between the successive segments, regions, or divisions of a part or organ. Processes or parts annexed to or springing from such segments, regions, or divisions would be secondarily actinologous, while appendages of these latter again would be tertiary actinologues, and so on.

In this way we may have:—

1. Non-homologous analogues, *i. e.* parts which have a similarity of function without any similarity as to relative position, *e. g.* the legs of a lizard and those of a lobster.

2. Homologous analogues, *i. e.* parts which are similar both as to function and relative position, *e. g.* the wings of a bat and a bird.

3. Homogenetic homologues, *i. e.* parts which, on the evolutionary theory, have a genetic relation, *e. g.* the humerus of a horse and that of an ox.

4. Developmental homogens, *i. e.* homogenetic homologues

which arise similarly, whether they descend from the same ancestral part or not, *e. g.* some of the cranial bones of a Teleostean and of a mammal.

5. Ancestral homogens, *i. e.* homogenetic homologues which do not arise similarly, though probably descended from common ancestral parts, *e. g.* the legs of flies of diverse development.

6. Homoplastic homologues, *i. e.* parts closely similar as to relative position, but with no genetic affinity, or only a remote one, *e. g.* the ventricles of a bat and a bird.

7. Homogenetic serial homologues, *i. e.* different parts of one individual, the correspondence between which is to be accounted for genetically, *e. g.* perhaps any two somites of the abdomen of a lobster (?).

8. Homoplastic serial homologues, *i. e.* different parts of one individual, the correspondence between which is to be accounted for by the influence of external conditions (the "superinduced segmentation" of Mr. Herbert Spencer), *e. g.* the fore and hind limbs of one side of any mammal.

9. Vertical homologues, *i. e.* different corresponding parts of one individual, of which one part is dorsal the other ventral, *e. g.* dorsal and anal fins of certain fishes.

10. Lateral homologues, *i. e.* different corresponding parts of one individual, of which one part is right and the other left, *e. g.* the right and left arms of a man.

11. Antero-posterior homologues, *i. e.* different corresponding parts of one individual, of which one part is anterior, the other posterior, *e. g.* the mouth and the cloaca.

12. Radial homologues, *i. e.* different corresponding parts of one individual which radiate from a central axis, *e. g.* any two arms on the same starfish.

13. Homotrophic homologues, *i. e.* parts of an individual the correspondences between which are regarded as due to internal modifying influences, *e. g.* the eyes and the ears.

14. Serial homotrophes, *i. e.* homotrophic homologues the correspondence between which is antero-posterior, *e. g.* an extra thumb and an extra great-toe on the same side of the same man.

15. Vertical homotrophes, *i. e.* homotrophic homologues which correspond vertically.

16. Lateral homotrophes, *i. e.* homotrophic homologues of the two sides of one individual, *e. g.* the right and left eyes.

17. Antero-posterior homotrophes, *i. e.* homotrophic homologues which correspond antero-posteriorly.

18. Actinologous homologues, *i. e.* successive subdivisions, parts, or regions of a part or segmented organ, *e. g.* two successive joints of an antenna of a lobster, or the vertebral and sternal parts of the same costal element.

19. Serial actinologues, *i. e.* segments, parts, or regions of one part or organ which correspond with segments, parts, or regions of another serially homologous part or organ, *e.g.* a protopodite of an ambulatory leg and a protopodite of a swimmeret of the same lobster.

20. Secondary actinologues, *i. e.* appendages annexed to successive segments, parts, or regions of a part or organ compared one with another, *e. g.* two appendages belonging respectively to two successive joints of an antenna, or two teeth of the same side of the same jaw.

21. Serial secondary actinologues, *i. e.* appendages annexed to successive segments, parts, or regions of a part or organ compared with corresponding appendages annexed to successive segments, parts, or regions of another and corresponding (serially homologous) part or organ, *e. g.* the radial tuberosity and the tibial trochanter, or processes of two successive branchial arches.

22. Correlated secondary actinologues, *i. e.* secondary actinologues which have a mutual correlation one to the other, *e. g.* the series of teeth of the same side of the same jaw.

23. Correlated serial secondary actinologues, *i. e.* serial secondary actinologues which have a mutual correlation, *e. g.* the upper and lower teeth of the same side of the same individual.

24. Special homologues, *i. e.* parts of two organisms belonging to the same *special** skeletal category, *e. g.* the basioccipital of man and the cod.

25. General homologues, *i. e.* parts of two organisms belonging to the same *general* skeletal category, *e. g.* vertebral centra of man and the cod, or lateral appendages of the lobster and scorpion.

In this way may be clearly distinguished different kinds and degrees of relationship perceived according as the mind is directed along one line of inquiry or another, whether concerning different individuals or different parts of the same individual, and whether concerning derivation, process of development, relative position, or function.

These distinctions could, no doubt, be easily augmented or improved, and they are here set down for augmentation or emendation.

It may or may not be well (I think it will be well) to distinguish these different relationships by distinct terms; but

* Special and general homologies were defined and explained by Professor Owen in his book on the archetype and homologies of the vertebrate skeleton (pp. 1 & 72).

anyhow they must be kept clear and distinct in the mind in order to make progress in scientific zootomy.

While protesting against the abandonment of the very useful, nay, necessary term "homology," I accept with pleasure Mr. Lankester's new terms, and thank him very cordially for this latest contribution to philosophical anatomy.

IX.—*On some Genera and Species of Gasteropodous Mollusca collected by* Mr. M'Andrew *in the Gulf of Suez.* By Arthur Adams, F.L.S.

Mr. M'Andrew having submitted to my inspection numerous small and obscure forms of marine gasteropodous Mollusca, for the purpose of identification, I have made a careful examination and comparison of them, to assist him in his researches into the geographical distribution of Mollusca, and have included the results in this paper.

Fam. Rissoidæ.

Genus Ceratia, H. & A. Ad.

C. pyrgula, A. Ad.

C. testa turbinato-turrita, imperforata, alba, tenui, nitida, semiopaca, spira apice obtusa; anfract. 5, convexis, suturis profundis; apertura ovata, antice vix effusa et subdilatata; labio arcuato, acuto.

Hab. Gulf of Suez.

A turreted, turbinate, semiopaque white shell, with the apex of the spire very obtuse, and with the aperture somewhat effuse and dilated anteriorly.

Genus Microstelma, A. Ad.

M. concinna, A. Ad.

M. testa ovato-turrita, imperforata, alba; anfract. 7, planis, postice angulatis, supremis longitudinaliter plicatis, plicis rectis, validis, æqualibus, interstitiis transversim striatis; anfractu ultimo magno, plicis evanidis; apertura oblongo-ovata, antice producta, effusa; labio arcuato, simplici; labro postice ad suturam angulato.

Hab. Gulf of Suez.

The only other shell I have seen resembling this somewhat worn specimen found by Mr. M'Andrew is *Microstelma dædala*, A. Ad., from the Gotto Islands, in Japan (Ann. & Mag. Nat. Hist. 1863, xi. p. 348). The nucleolar whorls are unfortunately

broken off. It has the aspect of a Pyramidellid; but, from the absence of plaits on the columella, I should prefer to place it with the Rissoids.

Genus Corena, A. Ad.

Testa elato-turbinata, rimata, spira apice obtusa; apertura circulari, peritremate continuo; labio callo tenui expanso obtecto, et postice tuberculo acuto instructo; labro margine duplicato, extus valde reflexo.

Resembles in form some species of the little Bulimoid group called *Ena* by Leach; but it has a double peritreme, and the inner lip is furnished posteriorly with a dentiform tubercle. The genus seems nearer *Onoba* than any other form with which I am acquainted.

C. tuberculifera, A. Ad.

C. testa elato-turrita, rimata, albida, tenui, subpellucida, apice spira obtusa; anfr. 5, convexiusculis, longitudinaliter oblique striatis.

Hab. Gulf of Suez.

Genus Rissoa, Fréminv.

R. gracilis, A. Ad.

R. testa aciculato-turrita, alba, solida, in medio convexiuscula; anfr. 8, convexis, longitudinaliter costatis, costis confertis; apertura ovata; labro arcuato, dilatato.

Hab. Gulf of Suez.

The only species of *Rissoa* proper which at all resembles this very elegant little shell is *R. auriscalpium*, Linn., which, however, is much larger, and has not the regular, longitudinal, rather crowded ribs of this shell. Only a single specimen was obtained.

Genus Onoba, H. & A. Ad.

O. mirifica, A. Ad. Ann. &. Mag. Nat. Hist. 1863.

Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

Genus Fenella, A. Ad.

1. *F. pupoides*, A. Ad. Ann. & Mag. Nat. Hist. 1860.

Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

2. *F. scabra*, A. Ad. (*Dunkeria*), Ann. & Mag. Nat. Hist. 1860.

Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

3. *F. reticulata*, A. Ad. (*Dunkeria*), Ann. & Mag. Nat. Hist. 1860.

   Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

4. *F. rufocincta*, A. Ad. (*Dunkeria*), Ann. & Mag. Nat. Hist. 1860.

   Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

Genus Hyala, H. & A. Ad.

1. *H. nitida*, A. Ad.

H. testa elato-turbinata, imperforata, albida, tenui, lævi, nitida, semipellucida; spira apice obtusa; anfract. 6, convexis, ad suturas subangulatis, suturis profundis, anfractu ultimo rotundato; apertura ovata; labio vix reflexo; labro arcuato, simplici, margine acuto.

Hab. Gulf of Suez.

Very similar in form to the succeeding species; but the axis is not perforated, the inner lip is hardly reflexed, and the whorls are angulated at the sutures.

2. *H. concinna*, A. Ad.

H. testa elato-turbinata, perforata, alba, tenui, lævi, subdiaphana; spira apice obtusa; anfract. $5\frac{1}{2}$, convexis, suturis impressis, anfractu ultimo rotundato; apertura ovata, antice subeffusa; labio vix reflexo; labro margine acuto.

Hab. Gulf of Suez.

A pretty shell, more nearly resembling the type of *Hyala* than any other form with which I am acquainted, but the true position of which must remain doubtful until the animal shall have been discovered and examined.

3. *H. pumila*, A. Ad.

H. testa elongato-turbinata, imperforata, alba, lævi, pellucida; spira apice obtusa; anfract. 4, planiusculis, suturis marginatis; anfractu ultimo magno, elongato; apertura ovata, peritremate continuo; labio subincrassato; labro margine arcuato, subdilatato.

Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

This pretty little shell, which appears to be identical with specimens I found in Japan, resembles in form some species of *Onoba*, but is smooth and nearly pellucid, and has the obtuse spire seen in *Hyala*. The inner lip being continuous with the outer, also, reminds one rather of *Onoba* than of *Hyala*.

Fam. **Litiopidæ.**

Genus Diala, A. Ad.

1. *D. varia*, A. Ad. Ann. & Mag. Nat. Hist. 1861.
   Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

2. *D. suturalis*, A. Ad. (*Monoptygma*), Sow. Thes. Conch. (*Monopt.*) pl. 172. f. 31, 33.
   Hab. Gulf of Suez (M'Andr.), Philippines (Cuming).

3. *D. succincta*, A. Ad.

D. testa turrito-pyramidali; spira conica, elata; lævi, solida, polita, lutescente, fascia angusta rufa ad suturas ornata; anfr. 8, planis, transversim obsolete sulcatis; anfractu ultimo antice fascia rufa succincto; apertura ovata, antice producta et acuminata; labio rectiusculo, fusco tincto; labro arcuato, simplici.

Hab. Gulf of Suez.

A pretty species, quite distinct from any hitherto described, being elevated and conical, with the aperture very much produced and narrowed in front.

Genus Alaba, H. & A. Ad.

1. *A. imbricata*, A. Ad. Ann. & Mag. Nat. Hist. 1862.
   Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

2. *A. lucida*, A. Ad. Ann. & Mag. Nat. Hist. 1862.
   Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

Genus Styliferina, A. Ad.

1. *S. goniochila*, A. Ad. Ann. & Mag. Nat. Hist. 1860.
   Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

2. *S. callosa*, A. Ad.

S. testa turbinata, alba, vitrea, vix pellucida, nitidissima, polita; anfract. norm. 4, convexis, sutura marginata; anfr. ultimo basi convexo, regione umbilicali callo obtecta; apertura ovato-lunari, labio obliquo, superne incrassato, antice subeffusa.

Hab. Gulf of Suez.

A small, polished, semipellucid shell, of turbinate form, and with the umbilicus covered with a shining callus. The apical nucleolar whorls are broken off; but the genus seems to be *Styliferina*, which more resembles *Alaba* than *Stylifer* proper.

Fam. **Pyramidellidæ.**

Genus Pyramidella, Lam.

P. mitralis, A. Ad., Sow. Thes. Conch. (*Pyr.*) pl. 172. f. 9.
Hab. Gulf of Suez (M'Andr.), Philippines (Cuming).

Genus Obeliscus, Humphr.

1. *O. terebellum*, Müll. (*Helix*), Verm. p. 123. no. 319; Sow. Thes. Conch. (*Obel.*) pl. 171. f. 5, 6.
Hab. Gulf. of Suez (M'Andr.), West Indies (auct.).

2. *O. tessellatus*, A. Ad., Sow. Thes. Conch. (*Obel.*) pl. 171. f. 16.
Hab. Gulf of Suez (M'Andr.), Philippines (Cuming).

3. *O. pusillus*, A. Ad., Sow. Thes. Conch. (*Obel.*) pl. 171. f. 7.
Hab. Gulf of Suez (M'Andr.), Philippines (Cuming).

4. *O. vitreus*, A. Ad. Ann. & Mag. Nat. Hist. 1860, vi. 335.
Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

Genus Syrnola, A. Ad.

1. *S. pulchella*, A. Ad. (*Obeliscus*), Sow. Thes. Conch. (Mon. *Obelisc.*) pl. 171. f. 20.
Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

2. *S. aclis*, A. Ad. (*Obeliscus*), Sow. Thes. Conch. (Mon. *Obel.*) pl. 171. f. 30.
Hab. Gulf of Suez (M'Andr.), Philippines (Cuming).

3. *S. aciculata*, A. Ad. (*Obeliscus*), Sow. Thes. Conch. (Mon. *Obel.*) pl. 171. f. 21.
Ob. ornatus, Gld.
Hab. Gulf of Suez (M'Andr.), Philippines (Cuming), Japan (A. Ad.).

4. *S. pupina*, A. Ad. Ann. & Mag. Nat. Hist. 1860.
Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

5. *S. subulina*, A. Ad. Proc. Zool. Soc. 1862.
Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

6. *S. lucida*, A. Ad.

S. testa acuminato-conoidea, imperforata, semipellucida, vitrea, nitida; anfract. norm. 5, planis, ultimo amplo, ad basin rotun-

dato; apertura subquadrata, plica parietali conspicua, transversa.

Hab. Gulf of Suez.

Most nearly resembles *S. pyramidalis*, A. Ad., but is not umbilicated. It is also like *Ob. vitrea*, A. Ad., but is without any coloured red band on the whorls.

Genus Orina, A. Ad.

Testa vitrea, conico-turrita, umbilicata; anfractibus planis, simplicibus. Apertura subquadrata, plica parietali unica transversa instructa.

O. pinguicula, A. Ad.

O. testa conoidali, profunde umbilicata, alba, tenui, lævi; anfr. norm. 5, planis, suturis canaliculatis; apertura subquadrata, antice subangulata; plica parietali transversa, valida; labro intus transversim sulcato.

Hab. Gulf of Suez.

Like a short umbilicated *Syrnola*. *S. pyramidalis*, A. Ad. (Ann. & Mag. Nat. Hist. 1860) also belongs to this newly indicated group.

Genus Styloptygma, A. Ad.

1. *S. lendix*, A. Ad. Proc. Zool. Soc. Lond. Nov. 1862.

Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

2. *S. nivea*, A. Ad.

S. testa subulata, in medio tumidula, solida, eburnea, nivea, polita; anfract. norm. 6, planulatis, suturis marginatis; apertura elongato-ovata; plica parietali subinconspicua, perobliqua; labio simplici, acuto.

Hab. Gulf of Suez.

A solid, ivory-white, highly polished species, with an elongated aperture, and with the plait on the inner lip very oblique.

Genus Monoptygma, Gray.

M. fulva, A. Ad. Proc. Zool. Soc. 1851; Sow. Thes. (Mon. *Monopt.*) pl. 172. f. 23.

Hab. Gulf of Suez (M'Andr.), Philippines (Cuming).

Genus Myonia, A. Ad.

M. casta, A. Ad. (*Monoptygma*), Sow. Thes. Conch. (Mon. *Monopt.*) pl. 172. f. 22.

Hab. Gulf of Suez (M'Andr.), China Sea (A. Ad.).

Until the animals of *Monoptygma*, *Myonia*, and *Agatha* shall have been examined, it is difficult to say whether they should be placed in Pyramidellidæ or Actæonidæ.

Genus Agatha, A. Ad.

A. vitrea, A. Ad.

A. testa subulata, alba, vitrea, semipellucida; anfract. 6, planulatis, sulcis transversis distantibus exaratis; apertura elongato-ovata, antice producta et effusa; labio in medio oblique subplicato.

Hab. Gulf of Suez.

This is a species of a group of shells of which *A. virgo*, A. Ad., is the type. They are beautiful white, polished, vitreous shells like elongated *Actæones* or, rather, *Myoniæ*, but without the sculpture peculiar to those forms.

Genus Mormula, A. Ad.

M. Macandreæ, A. Ad.

M. testa subulato-turrita, crassa, solida, rissoidea, alba; anfract. normalibus 11, planis, hic et illic valde varicosis, longitudinaliter costatis, transversim totis liratis, fasciis duabus rufis ornatis; apertura subquadrata; labio spiraliter tortuoso; labro extus valde varicoso, margine arcuato.

Hab. Gulf of Suez.

This shell agrees generically with the *Mormula egregia*, A. Ad., from the Philippines (Proc. Linn. Soc. Zool. vol. vii.), but specifically it differs in the whorls being ornamented with but two red-brown bands instead of three, and being provided here and there with strong conspicuous varices. *M. rissoina*, A. Ad. (Proc. Linn. Soc. Zool. vol. vii.), from Japan, *Lancea*, sp., Pse., from the Sandwich Islands, and probably *Proto Cornelliana*, Newcombe (Am. Journ. Conch. vol. v. pl. 17. f. 3), are examples of the same type. In two of Mr. M'Andrew's specimens the little embryonic sinistral shell is well shown—proving the genus to belong to Pyramidellidæ. It most nearly resembles *Turbonilla*; but the inner lip is not straight and simple as in that group. *Pyramidella aclis*, A. Ad. (Sow. Thes. Mon. Pyram. pl. 172. f. 16, 17), and *Pyramidella ambigua*, Gould (Otia Conch. p. 60), also belong to this genus.

Genus Turbonilla, Risso.

1. *T. bifasciata*, A. Ad. Ann. & Mag. Nat. Hist. 1861.

Hab. Gulf of Suez (M'Andr.), China (A. Ad.).

2. *T. acicularis*, A. Ad. (*Chemnitzia*), Proc. Zool. Soc. 1853, p. 182.
   Hab. Gulf of Suez (M'Andr.), Philippines (Cuming).

3. *T. metula*, A. Ad. (*Chrysallida*), Ann. & Mag. Nat. Hist. 1860.
   Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

4. *T. candida*, A. Ad. (*Chemnitzia*), Proc. Zool. Soc. 1853, p. 181.
   Hab. Gulf of Suez (M'Andr.), Philippines (Cuming).

5. *T. fusca*, A. Ad. (*Chemnitzia*), Proc. Zool. Soc. 1853, p. 181.
   Hab. Gulf of Suez (M'Andr.), Philippines (Cuming).

6. *T. decussata*, A. Ad. Ann. & Mag. Nat. Hist. 1861.
   Hab. Gulf of Suez (M'Andr.), China Sea (A. Ad.).

7. *T. scitula*, A. Ad. Ann. & Mag. Nat. Hist. 1861.
   Hab. Gulf of Suez (M'Andr.), China Sea (A. Ad.).

8. *T. modica*, A. Ad. Ann. & Mag. Nat. Hist. 1860.
   Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

Genus CINGULINA, A. Ad.

C. circinata, A. Ad. Ann. & Mag. Nat. Hist. 1860.
Hab. Gulf of Suez (M'Andr.), Japan (A. Ad.).

Fam. **Styliferidæ.**

Genus SCALENOSTOMA, Desh.

S. Deshayesii, A. Ad.

S. testa elongato-pyramidali, superne attenuata, spira styliformi, albida, nitida, semiopaca; anfract. normalibus 7, primis convexiusculis, sequentibus planulatis, ad suturas acute carinatis; anfractu ultimo in medio carinato, basi convexo; apertura ovali, antice subeffusa; labro arcuato, in medio producto.

Hab. Gulf of Suez.

This shell seems to have all the characters of M. Deshayes's *Scalenostoma carinatum*, described in his 'Cat. des Mollusques de l'île de la Réunion,' pl. 7. f. 26, 28. *S. Deshayesii* has the form of a *Rissoina* with the texture and spire of a *Stylifer*. The inner lip is not so straight as in the Bourbon shell, and the spiral keel is less acute and defined. In his specimens

M. Deshayes was unable to ascertain if the nucleolar whorls were arranged in the form of a little sinistral embryonic shell, as they are in all true Pyramidellids; and, unfortunately, neither is Mr. M'Andrew's shell in a condition to prove the fact, the apex of the spire being broken off. I am of opinion, however, that *Scalenostoma* belongs to Styliferidæ, and probably should include *Chemnitzia Rangii* of Folin, Méléagrinicoles, pl. 6. f. 1.

X.—*Remarks on* Prof. Owen's *Monograph on* Dimorphodon. By Harry G. Seeley, F.G.S., Assistant to Prof. Sedgwick in the Woodwardian Museum of the University of Cambridge.

In this work several views are urged in osteology which seem to me inconsistent with facts; principles in philosophy are advanced which, if true principles, must place the science of physiology upon a different foundation from that which it has now; and a position is taken by Prof. Owen towards previous writers and with his readers which, if not new, demands explanation before the scientific truths of the memoir will be fairly stated.

I would guard myself here from the suspicion that I may be writing merely to correct mistakes or point out oversights. No writer can afford to do that. And errors of that kind are only defects, often unaccountable, in contributions to knowledge which are made in strivings to attain to truth. But all through this monograph there runs a bias which warps its osteology and philosophy, and leads to conclusions which seem to me to be erroneous, unscientific, and unjust. The passages which will be extracted from the monograph will make this clear, while the remarks appended will contribute the best elucidation of the truth that I can give.

First, of Osteology.—This is descriptive of specimens of *Dimorphodon* from the Lias, and interpretative of the osteology of the whole class of these animals by the evidence from the specimens described. Prof. Owen begins with the skull. Herein, so far as the general osteology went, he was preceded by Von Meyer and other comparative anatomists of Germany, whose labours have cleared the chief difficulties from the subject. Upon the skull Von Meyer is quoted and argued against, but, I think, both misunderstood and misrepresented; so that it has seemed to me desirable to reproduce as well as I was able in English the following account which Von Meyer

gives of the skull in Ornithosaurians from the Lithographic slate*.

"The skull of the Pterodactyles, which Oken placed between Chameleon and Crocodile, after all can only be compared to the skulls of birds and of lizards. The preponderating resemblance to the bird's head cannot be disputed; but, on the other hand, it has opposed to it a surprising dissimilarity in certain parts, which incline to the type of the Sauria. Several species are characterized by an exceedingly depressed snout, which occurs more frequently in birds. In other respects, also, the general shape of the head is more like birds than it is like reptiles, which show a cranium more or less flattened. The bats, which deserve notice as flying Vertebrata, are entirely mammalian animals, and totally different, especially in their heads. In Pterodactyles, as in birds, the bones of the skull blend together so imperceptibly that their sutures at best are only indistinctly seen, and are sometimes obliterated; while even in full-grown reptiles they are all to be made out with great distinctness. There is the more difficulty in ascertaining the structure of the Pterodactyle skull, since generally only the lateral aspect is exposed, and hence we get scarcely any information about its upper and under surfaces. Among the skulls which are exposed from the side, information is at times afforded by those in which the parts have suffered some displacement; but the separations so produced are to be accepted with great caution, for they do not always coincide with the real boundaries of the bones.

"The temporal bone in *Pterodactylus* contributes essentially to the formation of the arch of the skull or brain-case, which is considered to be one of the chief characteristics of a bird's skull, and finds no counterpart in the skulls of Lacertians. The snout also shows the most marked similarity to that of birds, since it comprises only one bone (regarded as the intermaxillary), which constitutes in *Pterodactylus* the anterior margin of the anterior nares: exceptions to this seem to be *Pterodactylus longicollum* and *P. scolopaciceps*. As in birds, the intermaxillary is prolonged backward as far as the region of the orbits, to the principal frontal bone, in the form of a bone-ridge (Knochenleiste). A similar intermaxillary ridge is also found in *Monitor*, but of less extent. The simple bone which constituted the beak in *Pterodactylus*, however, was not of a spongy nature, favourable for the reception of air, as in birds; and the reason probably was that the bone had not to

* From 'Zur Fauna der Vorwelt. Reptilien aus dem lithographischen Schiefer, &c.,' von Hermann von Meyer, (Frankfurt am Main, 1859. Folio) pp. 15, 16.

carry a horny beak. For this reason, also, it was not required that the intermaxillary ridge should become elastic or form a sort of hinge before it met the chief frontal bone, by which means, as is well known, the beak of birds becomes movable. It consists of dense solid bone, which at the utmost can only be distinguished from the other bones of the head (which are exceedingly thin, as in birds) by its presenting a finely striated surface, which, however, is also sometimes to be seen in other Pterodactyle-bones. Here, therefore, we see the beak of birds adapted to an animal with an immovable snout armed with teeth.

"How little the horny beak or the horny covering of the jaw is connected with the blending by anchylosis of the skull-bones, and with the formation of a bird-like intermaxillary, is demonstrated by the fact that in turtles the bones are seen to be separate; the toothless *Rhynchosaurus* also proves it, as does the *Dicynodon*, whose jaws show teeth and horn-covering at the same time, which one could hardly even deny to birds, if the two little teeth which subserve the rubbing through of the egg-shell were to be regarded as true teeth. Mayer of Bonn has proved those on the upper beak of the mature chick in the egg to be tegumentary structures*. The like structure is found in the crocodile, and to some extent in turtles also.

"The highest point in the profile of the skull is formed by the principal frontal bone. This accords with the arrangement in birds as much as does the fact that the principal frontal bone is double, bounds the whole of the upper and hind part of the orbit, and covers the greater part of the cerebrum, which consisted of two hemispheres, in which Oken recognized a resemblance to higher animals.

"The posterior vault of the skull is bird-like. The double parietal bone succeeds behind the principal frontal bone, and is constituted as in birds. Geoffroy, regarding the mastoid as the parietal, described this bone in birds as the interparietal.

"The supraoccipital seems to be single as in birds, and tolerably well expanded; it generally forms that part of the skull which lies furthest back. The side bone of the occiput [exoccipital] lies lower down, and was probably directed somewhat forward, as in birds. No information could be obtained about the lower bone of the occiput [basioccipital], owing to the lateral position in which the Pterodactyle skull is generally found. From the form, however, of the back part of the skull, it may be concluded that the foramen magnum must have been situate inferiorly, as in birds; and we may therefore assume that the head and neck were moved in the same way as in birds, and not as in mammals and reptiles.

* Froriep's Neue Notizen, No. 5. Bd. xx. Oct. 1841.

"The temporal bone lies on the outside of the parietal and principal frontal bones, and chiefly forms the temporal fossa. Anteriorly it does not appear to enter into the formation of the margin of the orbital cavities, as it does in birds, but is rather displaced here, as in the Sauria, by the postfrontal bone. This bone approximates to that of the chameleon; its hindmost branch (which cannot very well be regarded as a backward extension of the jugal) forms the exterior boundary of the temporal fossa, by uniting with a process, probably of the mastoid, since it can hardly be supposed to come from the exoccipital. I would here remark that the exterior closing of the cavity or ring for the passage of the temporal muscles also occurs in birds.

"The malar and superior maxillary do not follow the type of birds. The malar consists of a single bone, which forms the greater part of the anterior and inferior boundary of the orbit of the eye (which is surrounded with bones), and in this respect resembles most of all certain lizards, such as the dragons and Iguana. In birds the cavity for the eye is not generally closed below with bones; but whenever it is so closed, it is not by the malar bone.

"The process of the malar bone which ascends in front of the orbit connects itself, while closing the margin of the eye-cavity, with a bone descending from above. It is the more difficult to determine this bone, since immediately in front or at some distance from it is seen a similar bone, which points downward and attenuates towards the end. Of these two bones the hinder one represents a similar bone in the bird's skull; only there, owing to the peculiar construction of the malar bone, it hangs down free, and has been termed by Bojanus correctly the lachrymal, and by others the supraorbital. In that case the foremost of the two bones is the prefrontal bone, which in birds is clearly developed at the back corner of the nostril. In certain living lizards (*Monitor*, *Iguana*, *Stellio*) the prefrontal bone also contributes towards the formation of the margin of the nares; and in Lacertians in general the lachrymal bone connects itself with the malar bone to form the front part of the border of the orbital cavity. In addition to this, there is to be found (in *Monitor*, for instance) a supra-orbital bone, which also characterizes certain birds.

"The great orbital cavities (bordered all round with bones) in the back part of the skull were at least partially separated by a bony partition, and contained, as in some lizards and birds, a bony ring for strengthening the sclerotic membrane. In some Pterodactyles this sclerotic ring seems to be absent; at least I have not yet been able to find it in *Rhamphorhynchus*.

When this ring is found, it either consists of a single smooth piece (*Pterodactylus scolopaciceps*, *P. crassirostris*) or is made up of small plates, which lie over each other, and which may be either smooth (*Pterodactylus Kochi*) or granulated (*P. Meyeri*).

"The nostril was double, and often distinguished by its large size. The two holes, however, were not separated internally by a partition of a partly bony consistence, as Oken supposed. In *Pterodactylus Kochi*, and still more distinctly in *P. longicollum*, it can be seen that the part which was thought to be the bony remnant of this septum is really the exterior bone, in which the anterior corner of the nostril is seen to be cut out. This bone, like most of the skull-bones of the Pterodactyles, is very thin. But as the intermaxillary ridge, which overlies it and extends to the principal frontal bone, is considerably thicker, as is also the lower margin of the jaw, which in that part is generally provided with teeth, it could not but happen, owing to the pressure to which these petrifactions have been subjected, that the thin exterior bone received a more depressed position in comparison with its borders. It thus acquired the appearance of a thin bony partition in the inside of the skull.

"Between the nostril and the orbit lies a third opening, which again reminds one of the bird's skull, which also possesses a boneless space between the prefrontal and lachrymal bones; this middle opening is seen to be completely surrounded with bones in the *Rhamphorhynchi*, where it is smaller and lies lower down, and also in some short-tailed Pterodactyles, as in *Pterodactylus crassirostris*, for instance, and perhaps also in *P. brevirostris* and *P. Meyeri*. In others, however, this opening is only partially separated by bones from the nostril, and varies in size according to the distance of the prefrontal from the lachrymal. These two bones are sometimes so near together, that the middle hole seems scarcely developed, or may even not be noticed at all, as, for instance, in *P. Kochi*; and *P. longicollum* and *P. rhamphastinus* may justify the conviction that there are Pterodactyles which really have no middle hole. Where the middle hole is completely bordered by bones, the separation between it and the orbital cavity is made by the malar and lachrymal bones; and the separation between it and the nostril is made, if not wholly, as in birds, at least for the most part, by the prefrontal bone, and probably only to a very small extent by the maxillary.

"One of the most important bones is the quadrate, to which the lower jaw articulates. This bone is not quadratic, as in birds, but cylindrical and shaft-like, which circumstance was

regarded by Cuvier and Oken as an infallible sign that the Pterodactyle was a saurian reptile, and not a mammal. In this, as in some other parts, the animal shows the greatest similarity to the chameleon, in which, however, the back of the skull is not arch-like, as in birds, but sharper in its backward prolongation, and therefore quite different from *Pterodactylus*. It is characteristic of *Pterodactylus* that the articulation of the lower jaw lies more or less in front of the posterior angle of the orbit. In birds this region lies further backward; and in lizards it is coincident with the posterior termination of the temporal fossa.

"At the same time the lower jaw of the Pterodactyle, except in being armed with teeth, closely resembles that of birds. The very firm union of its rami, their flat ledge-like form, their straight antero-posterior direction, and slight vertical curve, the facing of its articular surface (which lies rather backward), and the surprising shortness of the process which is behind it greatly remind us of the lower jaw in birds, and, among reptiles, of the chameleon and the turtle. Sometimes traces of sutures are visible, by which the composition of the lower jaw may be apparently made out. Externally, between the teeth and the articular cavity, is a small marginal ledge, separated by a suture, and on the lower margin of a similar ledge is seen the angular bone. On the space between these two ledges no other suture can be distinguished. It is not conceivable that the dentary bone, which forms the chief part of the lower jaw, extended as far back as the region of the articulation: it is rather to be presumed that the piece which lies between the two ledges belonged to the coronoid bone, although its anterior and posterior boundaries cannot be defined. In the crocodile the superior margin between the teeth and the articular cavity is formed by the coronoid bone, which in this region shares with the angular bone in chiefly forming the outer surface. In lizards the upper margin is bounded by the coronoid [Mondbein], which is not seen externally in crocodiles, but in the chameleon it forms a surprisingly strongly developed coronoid process which does not occur in Pterodactyles. In birds, however, as in Pterodactyles, one seems to see traces of a small upper marginal ledge, which would belong to the coronoid. The angular bone also shows itself externally in birds and lizards, as well as in Pterodactyles, only as a small marginal ledge; but at the same time, in birds and lizards, at the spot where both ledges terminate anteriorly, a clear separation between the coronoid and dentary bones may be seen. Hence it results that the lower jaw of the Pterodactyles, at any rate, is, even in its composition, only to be compared to

those of birds and lizards; but the foramen is missing from it which perforates the hinder half of the lower jaw in birds and in crocodiles. With all this resemblance, it is amazing to see the jaws armed with teeth, which are planted in separate alveoli, like those of crocodiles, and which have the successional tooth at the side of the old one, as in lizards. The mechanism of the hyoid bone is more bird- and reptile-like."

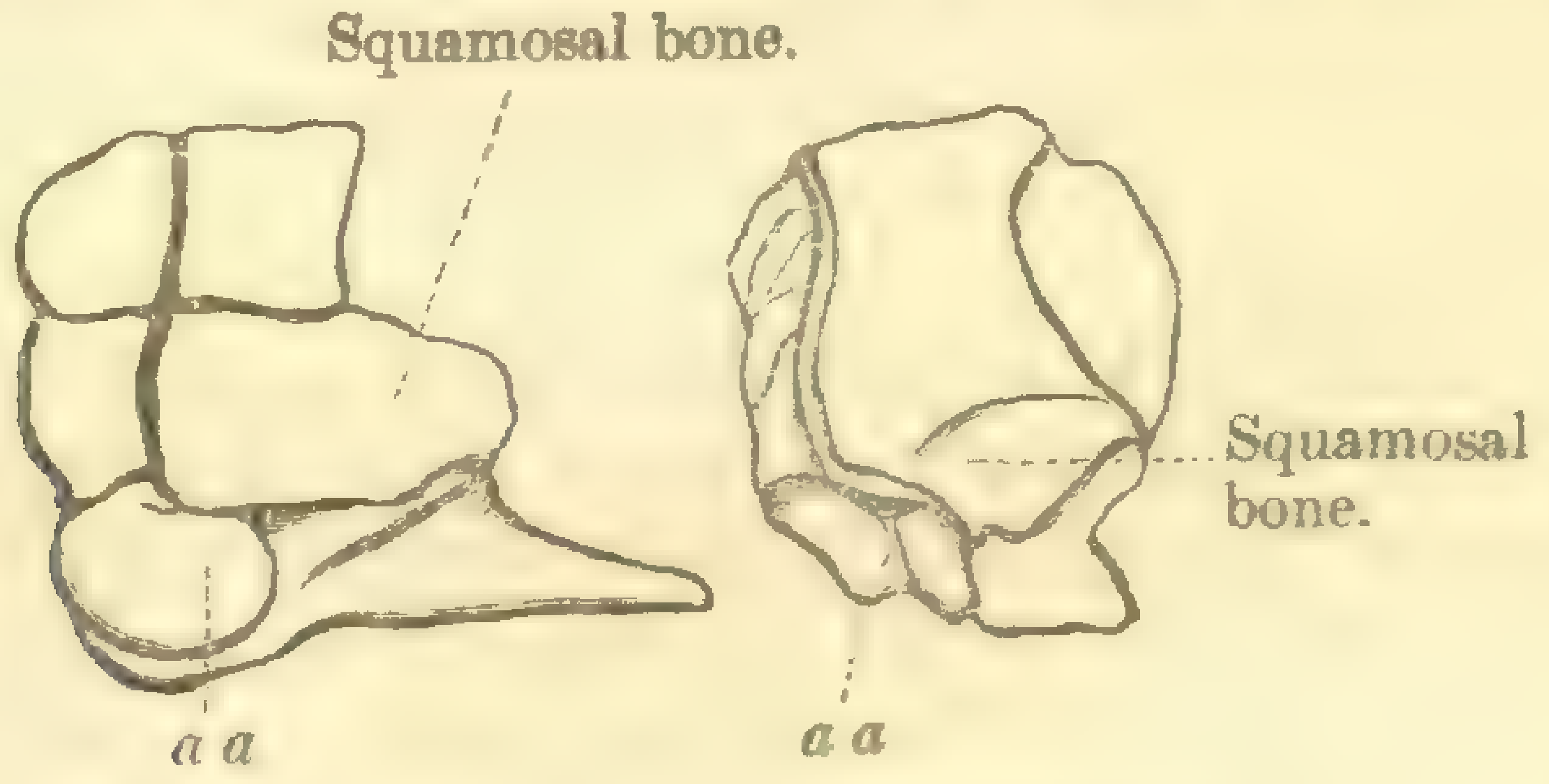
So far as the evidence goes, Von Meyer is clear about the avian character of the premaxillary bone. This Professor Owen ignores: but in the description of his plate 17 the premaxillary is made very small, after the manner of crocodiles; and the maxillary bone accordingly holds most of the teeth. This was the view held by Prof. Owen in his 'Odontography.' In the Palæontographical Society's volume for 1851 was figured the premaxillary bone of *Pterodactylus compressirostris* (Owen), which extended back to the nasal cavity, and demonstrated that the teeth were in the premaxillary bone. Accordingly Prof. Owen made a restoration of the skull, in which the premaxillary and maxillary bones have avian proportions. But in *Dimorphodon* it is said of the premaxillary, "*The pair*, by confluence or connation, constitute the fore part of the upper jaw" (p. 58). And in the description of plate 17 it is said, "Beyond the fourth alveolus the maxillary (20) appears, underlapping the part of the premaxillary (22″) which defines the lower and anterior part of the narial vacuity; the maxillary is continued straight backward," &c. (p. 43). This is substantially repeated at p. 58, where the length of the lateral alveolar rays of the premaxillary bone is given at about 1½ inch. Accordingly I turn to the figures: plate 17 is lettered to agree with the description; but plate 18 (the new specimen on which the monograph is chiefly founded) is lettered so as not to agree with the description, since the whole of the teeth are put into the premaxillary bone, which is represented after the type of Cretaceous and German Ornithosaurians, only of greater extent, and separated from the small maxillary bone by a well-marked suture. But at p. 64 it is said, "In no Pterosaurian has any obvious and unmistakable suture been seen indicative of the respective shares taken by maxillary (21) and premaxillary (22) in the formation of the dentigerous part of the upper jaw," &c. If so, it is not evident why Prof. Owen asserted, but a few pages before, that there was a suture, and described the extent and character of the alveolar rays of the premaxillary bone. If we are to believe this last statement, then it is evident that both views given in the plates are incorrect, and that every passage in

the text which describes the limit of the premaxillary bones is equally erroneous. Yet, notwithstanding this statement, Prof. Owen continues, in the next sentence: "Both bones combine to support the array of teeth; they have coalesced, at least at their external or faci-alveolar plates, as likewise have the right and left premaxillary portions forming the fore end of the upper jaw. The suture between this premaxillo-maxillary bone and the suborbital portion of the zygomatic arch remains. Accordingly there is a choice of analogies in the interpretation of the observed facts: a portion of the compound bone may be assigned to the premaxillary, according to the analogy of the crocodile and lizard; or the whole may be called premaxillary, according to the analogy of the Ichthyosaur." If the latter part of this paragraph is true, it convicts the former part of stating things about the bones which are obviously erroneous. But it is not clear why Professor Owen names an avian affinity Ichthyosaurian. It looks as though there was a foregone conclusion that the animal must be a reptile; and if not allied to living types, then it must be allied to a fossil reptile. But Prof. Owen is unable to determine the affinities of *Ichthyosaurus*; for in the 'Comparative Anatomy of the Vertebrates' it is both classified with the Monopnoa and written of as an extinct order of Dipnoal reptiles. In the 'Annals' for May 1866, I drew attention to the fact that, the teeth being in the premaxillary bone (as I inferred from Cretaceous and Solenhofen specimens, in accord with Von Meyer), they were simple and conical in most animals, and that the argument for their reptilian affinity on which Cuvier relied was worthless. Even if they had been in the *maxillary bone*, such an argument could have no value, since such teeth occur in Cetaceans. If Prof. Owen was battling against this fact, I think he has failed; nor has any evidence been adduced to overthrow Von Meyer's determination. The accusation against Von Meyer that he arbitrarily assumed the avian affinity of the bone is unjust, since the translation has shown he had found other avian affinities in the skull; while, even if the other affinities had been conspicuously Ichthyosaurian (which they are not), it would have been unphilosophical to affiliate the animal to *Ichthyosaurus*, which is not a known standard of organization.

On the lower jaw it is observed, "The dentigerous mandible, like the maxilla, speaks for the reptilian affinity of Pterosauria." This is contrary to fact. There is nothing in the dentition which might not be expected in a group of animals allied to Birds, while some of its more important features are characteristic of both mammals and reptiles. If the osteo-

logical affinities of birds are stronger with reptiles than with mammals, the teeth also might be expected, in a bird-ally, to have some reptilian characters. But to assert, without evidence or argument, that the dentition of these animals is reptilian, seems to dogmatize on a matter against which there is actual evidence and theoretical improbability. It can only be by suppression of facts that the teeth are named reptilian. No one has asserted that they are avian; but the absence of teeth from the jaws of *Echidna*, *Myrmecobius*, and *Balæna** among Mammals, and from the jaws of Chelonians* among Reptiles, is quite consistent with their having allies in which teeth are developed; and similarly the absence of teeth from the jaws of birds cannot militate against bird-allies having teeth, if such animals existed. If, therefore, it shall be evident that Pterodactyles have strong affinity with birds, it would be unphilosophical and untrue to speak of the dentigerous mandible as necessarily reptilian.

Prof. Owen makes a difficulty about determining Von Meyer's temporal bone. *Schläfenbein* is commonly used by German osteologists to indicate the bone in the skull which gives attachment to the lower jaw. In the higher Vertebrata Prof. Owen names this bone squamosal; in some of the lower Vertebrata the bone which has that function is named by Prof. Owen the mastoid. Hence the difficulty is not with Von Meyer, but follows from Prof. Owen's theory of the skull. Von Meyer is singularly clear about the relations of his temporal bone: entering into the brain-cavity as in birds, and forming much of the temporal fossa, it is exterior to the parietal and frontal bones, and does not enter into the orbit. These are the relations of the squamosal bone in the common cock; and I have accordingly (as the *Ornithocheirus* from the Cambridge Greensand entirely agrees in these points with Von Meyer's description) made a preparation of the skull of a chicken, which is here figured side by side with a Greensand



Bird. Pterodactyle.

* As is well known, teeth have been demonstrated in an early stage of life in *Balæna* and *Trionyx*.

Ornithosaurian cranium. It appears to me to demonstrate that there can be no doubt about Von Meyer's "*Schläfenbein*" being the squamosal, and that it is altogether avian.

Yet, notwithstanding this clear and incontrovertible evidence, Prof. Owen concludes that the result of his "analysis of a main ground of Von Meyer's assertion as to the incontestable similarity between the Pterosaurian and Avian types of cranial structure" has not a little tended to shake his confidence in the grounds on which Von Meyer pronounced definite judgment in the matter. If Prof. Owen was conversant with the facts, as I have here figured them, this is a gross misrepresentation of Von Meyer; and if he was not cognizant of the true structure of the bird's skull, the remarks upon Von Meyer which I have quoted should not have been written. German Ornithosaurians differ from birds in having a postfrontal bone of Lacertian form; but the fact that that bone may articulate with the squamosal does not alter the avian characters of the squamosal bone, which does not enter, in any reptile, into the formation of the cranial cavity.

Prof. Owen states that the quadrate bone (tympanic, Owen) is immovably articulated to the squamosal (mastoid, Owen), opisthotic (paroccipital, Owen), and quadrato-jugal (squamosal, Owen). These relations are not evident either from the description or figures of *Dimorphodon*. And, so far as the Ornithosaurians from the Cambridge Greensand are concerned, the statement is erroneous; for the quadrate bone had a free and bird-like articulation with the skull, and a bird-like union with the quadrato-jugal, with which bone in some species it is anchylosed. No specimens afford such facilities for examination as those from the Upper Greensand; and it is not improbable that identical characters occur in other Ornithosaurians, though in a group so large much variation may be anticipated.

In most birds there is in the skull a middle hole between the nasal and orbital holes; and in this character they are matched by most Pterodactyles. Prof. Owen reminds us that a representative of this foramen characterizes the extinct Teleosauria, and occurs in the recent lizard *Lyriocephalus*. But to stop with that statement is to convey to the reader who is not conversant with recent specimens an incorrect idea of affinity, since, to give an unbiased idea, it should have been added that in this character Pterodactyles are paralleled by numerous ruminant mammals. But any reasoning on affinity from isolated characters is obviously absurd; and this character, as reptilian, avian, or mammalian, can only have weight in the sum of those characters which define the animal's plan of structure.

The malar bone is discussed in a similar spirit, it being said that therein the Pterodactyles resemble Crocodiles. On all occasions resemblances to the crocodile are seen. Thus the squamosal bone (mastoid of Owen) is affirmed to resemble that of the crocodile; the postfrontal bone is likened to that of a crocodile; the middle hole of the skull is compared to lizards' and crocodiles'; the premaxillary in proportion is compared to lizards' and crocodiles'; the quadrate bone is compared to lizards' and crocodiles'; the mandible in some of its characters is compared to a fish's, in others to a crocodile's. All this has a tendency to make readers believe, if they have no other source of information, that the Pterodactyle skull is crocodilian, which it is not.

This crocodilian bias or taint running through Prof. Owen's memoir deprives his comparisons of all value; for it prevents him from stating the whole truth; and to state that the malar bone is crocodilian is so to state a truth as to make it convey an erroneous idea. The malar bone of the Ornithosauria may be said with equal truth to be chelonian, and, so far as its essential relations to the orbit, maxillary, and frontal bone go, might be compared to that of the Mammalia. The postfrontal, in those German Pterodactyles in which its characters are unmistakable, such as *P. scolopaciceps*, is certainly not crocodilian, but lacertian. In the Ornithosaurians from the Cambridge Greensand there is no evidence whether it existed; and if it was developed, it could only have been applied to the exterior of a bird-like cranium. And for the other alleged crocodilian characters, I can state that no one of them has even slight evidence to support it: the premaxillary there is no reason for thinking other than avian; and the quadrate bone is avian.

Then with regard to other bones which, in German Pterodactyles at least, present no ambiguity, Prof. Owen is silent. The parietal and frontal are such bones. It will be evident from Von Meyer, however, that they are not crocodilian; and if their resemblances to other animals were known to Prof. Owen, some indication of these affinities should have been given.

Then, with regard to the brain, it is said, "The lodgment of the poorly developed brain enlists a miserably small proportion of the skull" (p. 49)*. The epithet *miserably* does not state a scientific fact, and must be objected to as endeavouring to make a feeling of contempt do duty for a knowledge

* Prof. Owen (Anat. Vertebrates, vol. ii. p. 121) says, in the huge *Dinornis* the brain does not exceed 2½ inches in length, and 2 inches in width.

of structure. Immediately afterwards, however, it is justly remarked that the skull is enormously large in *Dimorphodon*, even for an Ornithosaurian. It is also remarked that "the parietals swell out slightly at the temporal foss, indicative of the size and saurian position of the mesencephalon"—that is, of the optic lobes. It is due to a correct appreciation of this fact to mention that in the Report of the Syndics of the Cambridge University Museums to the Senate for 1868–1869, Prof. Sedgwick stated that I had been able to prove, by casts [natural moulds] from the brain-cavity, that Pterodactyles possessed a cerebral organization as high as that of birds. A copy of that report was sent to Prof. Owen; and thereupon Prof. Owen wrote to me asking for a cast of the brain-cavity. No casts have been taken; and the specimen was placed in my hands on the condition that no casts were to be distributed till the specimen was figured and described by me. I accordingly mentioned to Prof. Owen the main facts proved by the specimen about its avian characters. Therefore, long before his monograph was published, Prof. Owen was aware that a specimen existed, and was about to be figured, which would show that the size and position of the mesencephalon was not saurian, but avian. Nor was Prof. Owen unaware of the value of this character; for in the 'Comparative Anatomy of the Vertebrates' it is said of the bird's brain, "It differs from the brain of every other class in the lateral and inferior position of the optic lobes."

I know nothing of the brain of *Dimorphodon*; but the second figure represents the outline of the cerebrum and cerebellum in an Ornithosaurian from the Cambridge Greensand. Another specimen* shows the lateral and inferior position of the optic lobes.

Strix otus. Pterodactyle. Ornithorhynchus. Crocodile.

o, optic lobes; *c*, cerebellum.

* Figured in my work on the Ornithosauria.

In the Pterodactyle here figured, the region of the cerebellum is only partly preserved, and, as is also proved by the fragments of the squamosal bones at the sides, was longer. On comparing it with the other figures, I do not think there can be any doubt that, so far as it differs from the bird's brain, it approaches mammals rather than reptiles. Now, since the Pterodactyle has an essentially avian brain, I hold that the legitimate inference in any case of divided affinity with regard to the skull-bones is that the true affinity is avian. Therefore I infer that the existence of middle holes in the Perodactyle skull is avian, and neither reptilian nor mammalian—and that those other points of structure which are common to reptiles are proved by these brains to be consistent with an avian plan of organization, and that in this case they were indispensable for its manifestation. If this result is legitimate (and I can see no bar against it, unless it were wholly contradicted by the remainder of the organism), the fact becomes one of the highest possible importance in the investigation of the fossil animals usually named reptiles, because it enables us to use the Ornithosaurian structures as data for comparison and reasoning, in a way that gives a new classificational value to the structures which approximate to them.

I next turn to the vertebral column. Here, too, Prof. Owen presses for a predominant crocodilian affinity. It is observed, "Counting the axis with the small coalesced atlas as one, I give seven cervical vertebræ to the *Dimorphodon macronyx*"—that is, eight cervical vertebræ; and it is added, "Cuvier concluded that there were not fewer than seven, as in Crocodilia and Mammalia, or more than eight, as in Chelonia." If those vertebræ in which the rib is partly supported by the neural arch and partly by the centrum are counted separately and named pectoral, then the crocodile has eight cervical vertebræ and Chelonians nine. Further on, Prof. Owen says that *Rhamphorhynchus Gemmingi* has six cervicals (counting the atlas and axis as one (though why this is done is not evident), and he suspects a seventh—concluding, "Thus it is plain that the Pterosauria exemplify the crocodilian affinity in the cervical region of the vertebral column." On this matter Prof. Owen has adduced no evidence except what I have quoted. Hence it is clear that even the number of vertebræ is not certainly in accord with crocodiles, and may be mammalian; while no Pterodactyle has ever shown the cervical ribs of a crocodile, any more than any crocodile has ever shown the neural arch or pneumatic foramina of a Pterodactyle; so that, so far from the case being as Prof. Owen represents it, no Pterodactyle has shown any evidence of crocodilian affinity in this part of its body.

Buckland's inference that the dorsal vertebræ are crocodilian is quoted with approval, and supported, though with the caution that the procœlian cup and ball is also Lacertian and limited among crocodiles to the newer type. In the Cretaceous Ornithosauria, on which I can speak with most confidence, the dorsal vertebræ no more show crocodilian characters than do the cervical vertebræ. Speaking very vaguely, it might be suggested that the typical mammalian modification of the earlier vertebræ is to have the ball in front, and the typical reptilian condition to have the cup in front, while in birds the cup and ball are combined in one anterior articular surface; but the exceptions are so considerable that the idea is merely suggestive of affinities. In young pigeons the cartilaginous epiphyses come away from the dorsal centrum, and leave flat or slightly concave articular ends—a condition characteristic of some dorsal vertebræ of Cretaceous birds. The procœlous articulation can only be a mark of crocodilian affinity in a crocodile.

On the sacrum it is remarked, "With all the evidence that the Pterosauria, like the Dinosauria and Dicynodontia, exceeded the sacral formulæ prevailing in existing Crocodilia and Lacertia, we should gain no firm ground therefrom for predicating avian affinity or for building thereon a derivative hypothesis of the class of Birds. Many existing Chelonian reptiles have a sacrum composed of more than two vertebræ." The Pterodactyle sacrum has nothing in common with that of any true (*i. e.* living) reptile. There is no evidence on record that I am aware of sufficient to prove that either Dinosaurs or Dicynodonts are reptiles. Nor have I ever seen three vertebræ anchylosed into a sacrum in any Chelonian; and even if such a specimen could be found, mere number of bones would not settle the question. On the other hand, the sacrum of an Ornithosaurian is very unlike that of a true bird.

On the tail it is said, "As we cannot, with Sömmerring, insist on the shortness of the tail in some Pterosauria as proof that they were birds, so neither can we conclude, from the length of the tail in other Pterosauria, that they were reptiles." But in this part of the skeleton Ornithosaurians differ in more important characters than the number of the vertebræ. The highly organized Cambridge family Ornithocheiridæ have caudal vertebræ in which the neural arch is persistent down the tail, as in reptiles and birds; while some at least of the German specimens have the mammalian modification in which the tail terminates with vertebræ from which the neural arches have disappeared, as in *Dimorphodon*.

From these considerations it seems to me that, without deviating from fact, Prof. Owen might have given to his account

of the vertebral column less of a crocodilian bias. If its procœlous character is reptilian, its pneumatic character is avian. In its details it has distinctive characters of its own.

Prof. Owen says of the scapular arch, it retains in Pterosauria its crocodilian simplicity. I may state that in *Dimorphodon* it has long been recognized as entirely avian, the scapula being much more bird-like than in *Ornithocheirus*. But upon the sternum of Ornithosaurians Prof. Owen remarks fully. After allowing that the bone is ornithic, in being shield-shaped and having a keel, it is compared in parts to Crocodiles and *Iguana*; while at page 70 is made this statement:—"In all cases in which it has been observed, the sternum of Pterosauria resembles in essential characters that of Crocodilia." And figures are given intended to suggest the same idea; while it is claimed that the sternum cannot be avian because no bird has shown any approach to the postcoracoid lateral emarginations which distinguish the sternum of *Ornithocheirus*. It would seem a very simple matter to determine whether the truth is here told. Certainly something very similar to the postcoracoid lateral emargination of *Ornithocheirus* occurs, among birds, in the *Merganser*. And wherein the distinctive and essential crocodilian characters of the sternum consist I cannot discover. It is not in the distinct synovial character of the facet for the coracoid; for in a previous writing Prof. Owen has said that Pterodactyles therein are only matched by birds. It is neither in the keel nor the lateral emarginations; for neither of these occur in the crocodile. I am compelled again to assert that Prof. Owen has here made statements which it will be impossible to justify.

Passing on to the carpus, it is said:—"A carpus with one large and one small bone in a proximal row, and with a second large and at least one smaller bone in a distal row, is another character by which the Pterodactyles manifest their closer affinity to reptiles than to birds. The remains of the gigantic species from the Cambridge Greensand have yielded the characters of the two larger carpal ossicles." I some time since pointed out that the carpal bone which Prof. Owen named scapho-cuneiform, and regarded as the proximal row, is really the distal, while the bone which was supposed to be distal is proximal. Osteologically a mistake of this kind is hard to avoid; but it is of considerable importance, since it would involve regarding the back of the hand as the front, and the "little finger" as the index finger. To the talon of the distal carpal was attached the lateral carpal or pisiform bone, which, as in *Chrysochloris*, supported the third bone of the forearm. The distal carpal shows the articular surface for the meta-

carpal of the wing-finger. Now, seeing that the pisiform bone is always on the side of the hand towards the little finger, it follows that the wing-metacarpal is on the side towards the index finger, and is the index finger, as in birds.

I here give for comparison diagrams of the carpus and metacarpus of the Ostrich and of the Pterodactyle *Ornithocheirus*; and I can only draw the conclusion that the carpus is essentially ornithic.

Carpus and Metacarpus of Ostrich.

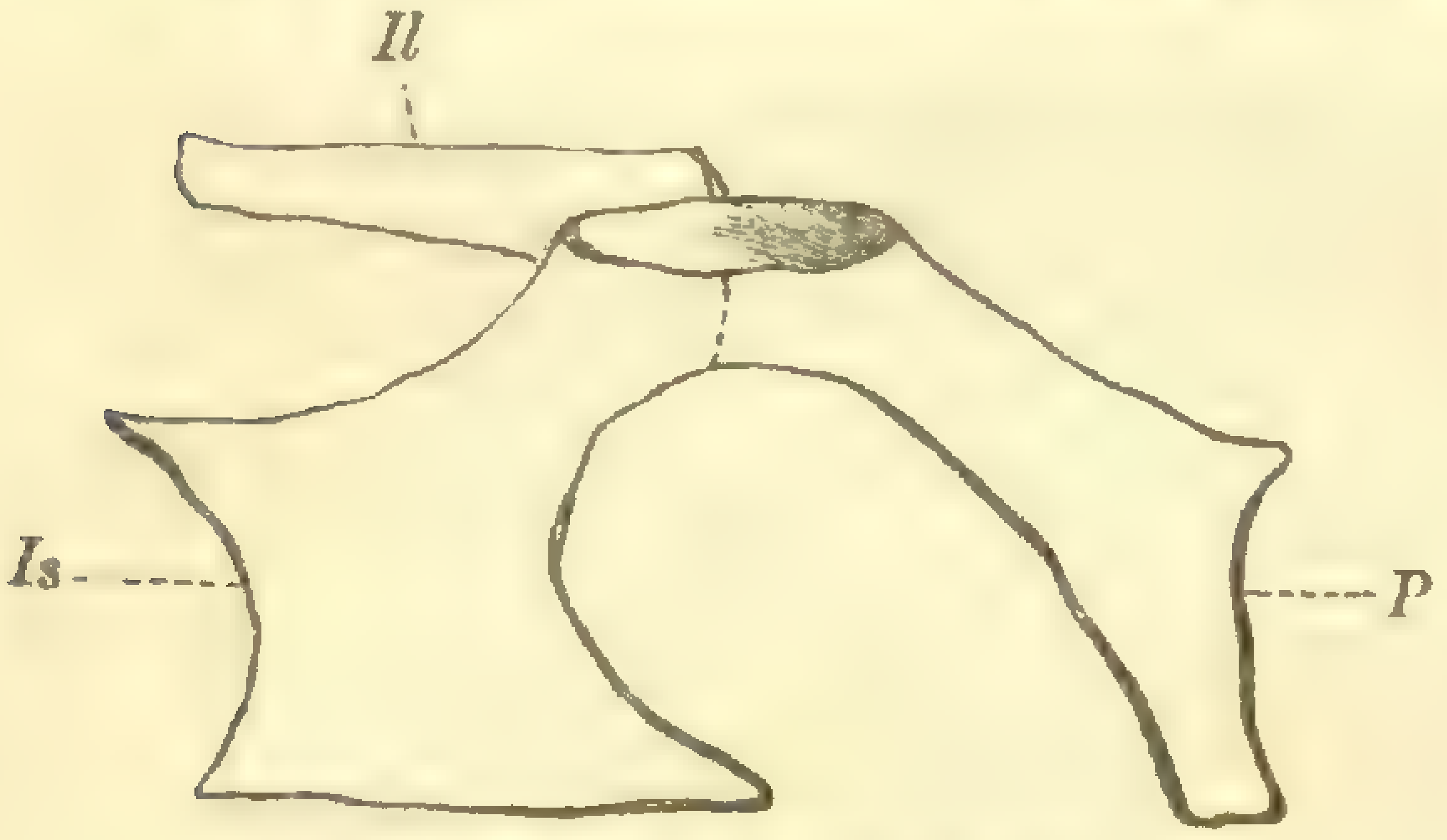
Carpus and adjacent bones of Ornithocheirus.

a, lateral carpal; *b*, ulna; *c*, radius; *d*, proximal carpal; *e*, distal carpal; *m*, index metacarpal; *n*, third metacarpal.

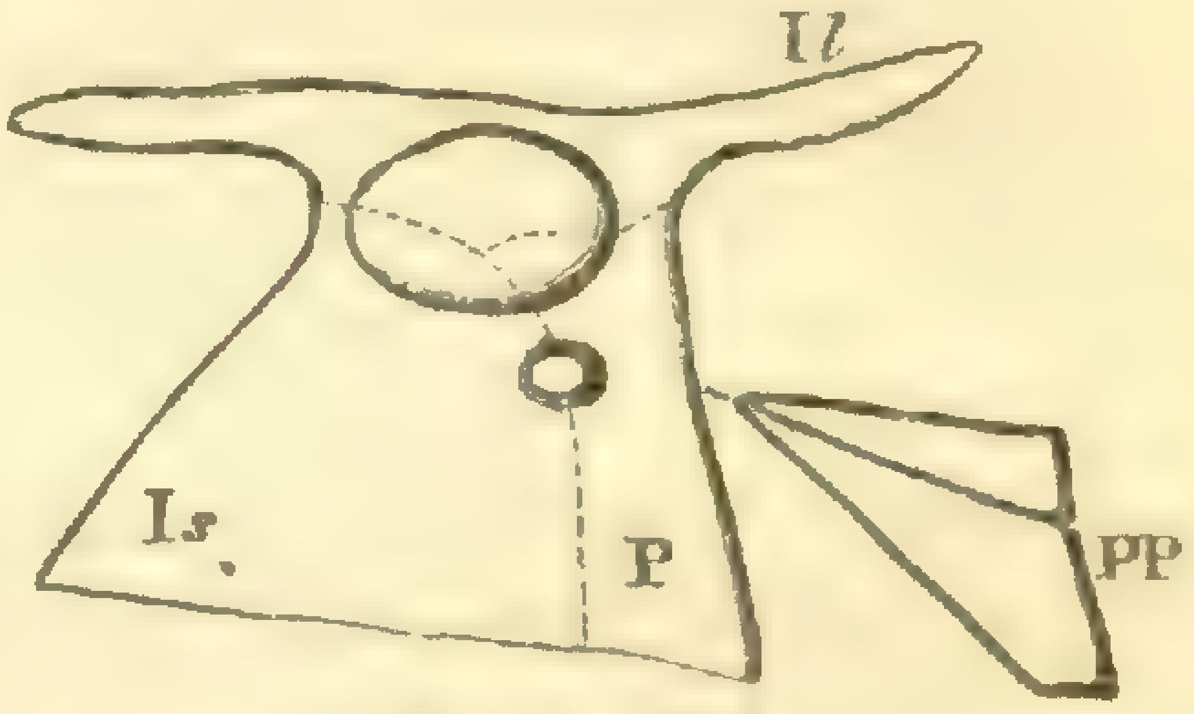
Among important bones there remains the pelvis. Prof. Owen figures the pelvis in the two different specimens, and in

the explanation adopts the reptilian views on the subject held by Von Meyer.

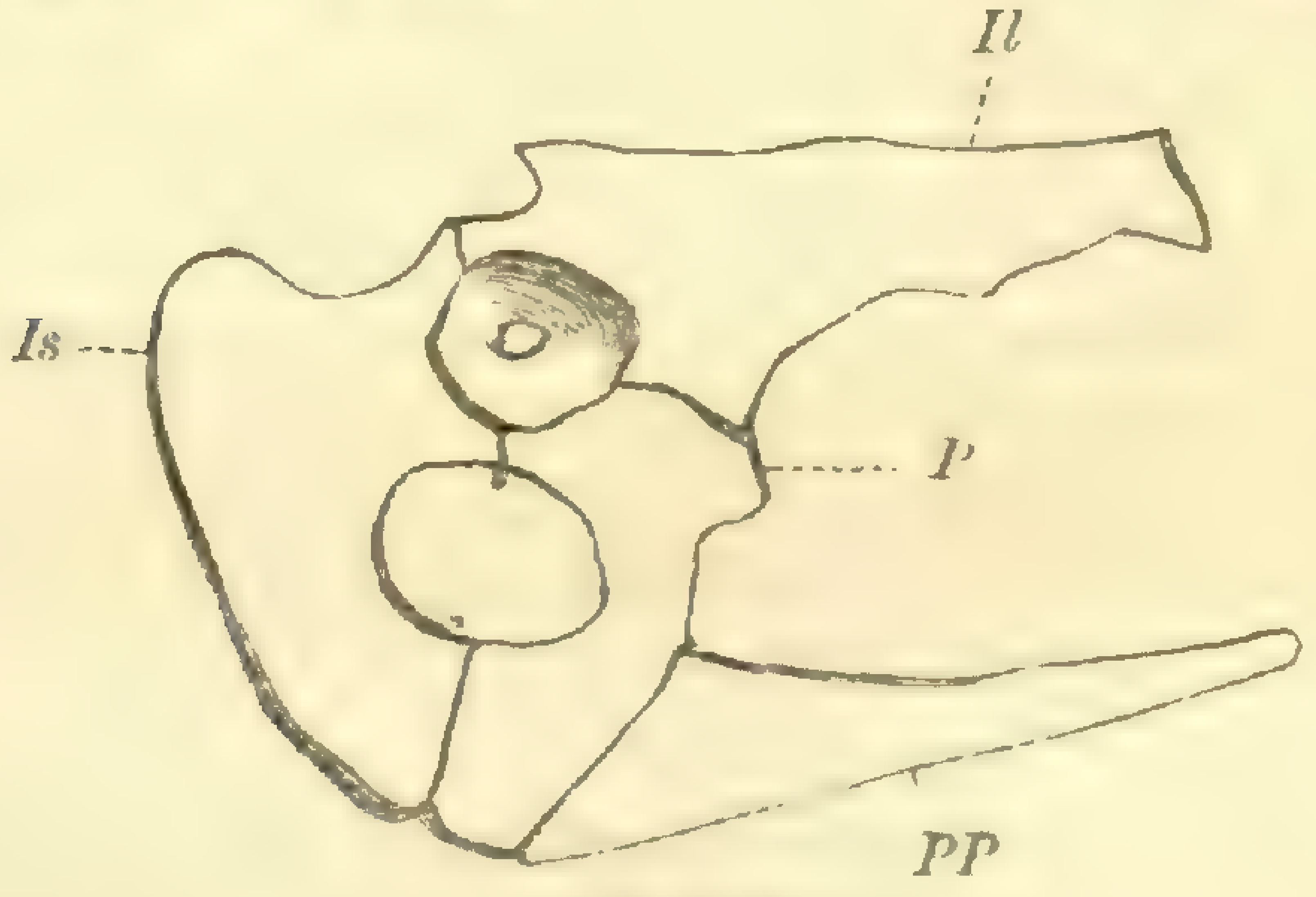
In the 'Fauna der Vorwelt' the case is stated thus. After remarking upon the reptilian character of the ischium, it is observed:—"This is still more applicable to the os pubis, which we have compared to the marsupial bones in certain mammals. In birds the os pubis is quite distinct, and indeed occupies a different position. It is a similar stiliform bone directed backward, and it takes part in the formation of the acetabulum. Wagner believes that in Pterodactyles the three pelvic bones take part in forming the pelvic acetabular cavities. The os pubis appears to me to be excluded therefrom, and to have degenerated to an appendage to the ischium. The exclusion of the os pubis from the acetabulum is observed, among saurians, in the crocodile." Two years ago a study of the original specimen of *Dimorphodon* convinced me that the bones which Von Meyer thought pubic, and compared to the marsupial bones, really were representatives of the marsupial bones; and as I was able to demonstrate the fact by the aid of Cambridge specimens, a paper was communicated to the Cambridge Philosophical Society "On the Mammalian Affinities of Pterodactyles." The fact was quoted by Mr. Clifford in a Royal-Institution lecture. Here is shown the arrange-



Iguana, seen from below.



Dimorphodon.



Echidna.

Il. Ilium; *Is.* Ischium; *P.* Pubis; *PP.* Prepubic.

ment in the original specimen, which is repeated in the new specimen described by Prof. Owen. It may be compared with the similar bones in *Echidna* and *Iguana*.

If the anterior free triangular bone is identified as the pubic, then the pelvis has most in common with the crocodile; but if the bone is the prepubic* or marsupial bone, then the pelvis is not reptilian but mammalian, and any superstructure of affinities built upon its presumed reptilian characters is obviously worthless.

The foramen below the acetabulum is a representative of the obturator foramen of the marsupials, which occurs between the ischium and pubis. In the Cambridge genera the os innominatum closely resembles that of *Dimorphodon*, and through the foramen passes the vertical suture which divides the pubis from the ischium, while a transverse suture divides the ilium from both the other bones. Therefore the bone which Prof. Owen has named the ischium is clearly both ischium and pubis, while the free triangular bone is as clearly no part of the pubis, but a prepubic bone, only comparable to the marsupial bones of mammals. This disposes of the crocodilian theory of the pelvis. I have seen the prepubic bone also in both the Pterodactylidæ and Rhamphorhynchidæ; and, like the other pelvic bones, it differs in form in the different families.

Finally, as a mark of osteological affinity Prof. Owen ignores the pneumatic foramina which are found in nearly all the bones, though they do not occur in Reptiles, and are characteristic of Birds.

From Prof. Owen's osteology the conclusions seem irresistible:—

First, that it was written with a bias in favour of the crocodilian and reptilian affinity of Pterodactyles.

Secondly, that the crocodilian affinity was a delusion which cannot be substantiated in a single point.

It is also clear that it was written as an argument against their affinity with birds. I cannot but think it undesirable that such bias should be introduced in science.

Secondly, of Philosophy.—Here the issues raised are of the gravest kind:—first, upon the method of determining an animal's affinities by comparing its skeleton with those of other animals; and, secondly, upon the method of determining affinities by physiological inferences from structure.

The following passage from Von Meyer is translated:— "The skull of Pterodactyles is essentially comparable only

* By an oversight this word has been printed "epipubic" in my book of Pterodactyles.

with that of Birds and Saurians. The preponderating resemblance with the bird's skull cannot be contested. Against this, however, is a remarkable dissimilarity in certain parts, which, on the other hand, approximates it to the type of Saurians." Prof. Owen's comment upon this is as follows:—"The term Sauria is here used in the sense of Brongniart and Cuvier; and it is open to the unbiased investigator, and, indeed, becomes plainly his business, to determine not merely whether avian or saurian characters predominate in the Pterosaurian skull, but to define the degree of affinity or correspondence of cranial structure therein traceable to such structures in Enaliosauria, Dinosauria, Dicynodontia, Crocodilia, Lacertia, each of which may be a group organically of coordinate value with Aves." This passage seems to me to strike at the very existence of comparative anatomy. The object with comparison is, I suppose here, to elucidate affinity,—that is, to be able to infer from the hard parts of the skeleton what were the soft and vital organs which determine the systematic place of the animal. This comparison can be made with birds, and with the living orders of reptiles, because the skeleton in them is the exponent of definite and known kinds of organization in the lungs, and heart, and brain, and reproductive organs. If it were not, comparison could give little or no clue to affinity. But in Enaliosauria, Dinosauria, and Dicynodontia not one of these organs is known; and I cannot but consider the packing of these groups into the Reptilia, in the absence of such knowledge or even of osteological coordination*, entirely subversive of scientific investigation. If such comparisons are made, the affinities must be spoken of as Dinosaurian or Ichthyosaurian for instance, but never as Reptilian; otherwise the word Reptile becomes meaningless, and we substitute personal fancies about an animal's affinities for knowledge; this would be the result of accepting Prof. Owen's views. Prof. Owen, however, has abstained from making any other comparisons of this kind, except those already noticed.

"The length and flexibility of the neck is correlated with the covering necessitated by the high temperature of the bird. The cold-blooded flying reptiles have a comparatively short and rigid neck," &c. (p. 67). Such a doctrine is misleading, since in many Plesiosaurs the neck is even longer than in birds, and often not less flexible; yet there is no ground for affirming that they were covered with feathers or had hot blood; while in mammals the neck is usually at least as short as in Pterosaurs. The argument about the covering is con-

* This I have attempted in a MS. catalogue of the Woodwardian Museum.

tinued in these passages:—"The plumous covering of the long-tailed bird of the period [*Archæopteryx*] proves its hæmatothermal character, as the want of it shows the long-tailed Pterosaur to have been cold-blooded" (p. 73). "The constant correlative structure with hot-bloodedness is a non-conducting covering to the body. We may with certainty infer that *Archæopteryx* was hot-blooded because it had feathers, not because it could fly" (p. 73). Living crocodiles, chelonians, lizards, and serpents are more or less perfectly covered with bony scutes or horny scales, or, as in the case of some chelonians, with both; neither of these conditions, nor, indeed, any covering is known in Ornithosaurs; therefore Prof. Owen has no reason for inferring from the covering of the body that the Pterodactyles were reptiles or that they were cold-blooded. Yet even scales might not be conclusive of reptilian character, for something analogous to a scaly covering is seen on the legs of birds; but to infer that the animals were cold-blooded because there is no evidence of their having had feathers, is plainly an absurdity. Not to mention other cases, our own species and whales are instances of warm-blooded animals in which the skeleton could show no trace of any non-conducting covering to the body, even if it existed; it therefore seems to me that in these matters Prof. Owen's philosophy has no basis in fact.

At p. 73 Prof. Owen argues against flight having any relation to high temperature; and he adds, p. 80, "By the pneumaticity of the bones of the Pterodactyle, it might be inferred from a single bone, or portion of bone, to have been an animal of flight. For, although certain volant vertebrates, *e.g.* the Bat and the Swift, may not have air-bones, no vertebrate, save of a volant kind, has air admitted into the limb-bones." In his remarks in support of the proposition that temperature does not depend on exertion, Prof. Owen quotes the beetle *Melolontha*, in which the temperature is only raised one degree above the temperature of the atmosphere by the work done in flight. Sharks are cited as animals not less active than Porpoises, and yet cold-blooded; and it is concluded, "With the cooling of the air in the summer-night the temperature of the *Melolontha* concurrently falls. So likewise would that of the flying reptile, whatever amount of oxidation and evolution of waste products in the form of carbonic acid might have attended their flight."

In these passages it appears to me that errors are made of two kinds:—first, in considering functions without regard to their correlative structures; secondly, in not reasoning from structures back to the functions of which they are the evi-

dence. On the first head, the energy of the individual is clearly not distinguished from the organization; for, in other words, the argument is, because a beetle flies and does not become hot-blooded by flight, so also the Pterodactyle which flew could not have been hot-blooded. The beetle is not comparable with a Pterodactyle, having a different plan of organization; and for the same reason the shark cannot be compared with the Cetacean. In both cases the energy of the individual may be greatest in the beetle and the shark, but the energy of their respective plans of organization is totally different. Flight alone would be no evidence of temperature; but the amount of oxidation and evolution of waste products is evidence, when it does not depend upon the individual muscular power, but upon the plan of structure characteristic of the race, because this arterialization cannot be stopped while life lasts, even by absolute muscular quiescence. The amount of heat manifested in arterialization is now being determined by Dr. Gamgee. But seeing that the combustion of one pound of carbon in oxygen is found to heat 8080 pounds of water one degree Centigrade, it is probable that some considerable heat is due to this cause. And the considerations urged by Prof. Owen against an animal's temperature being dependent upon exertion, seem to me not in accord with physics, and to support the views against which they are adduced; for I think Prof. Owen has not distinguished between an animal's kinetic energy and its potential energy, without which physiology as a philosophy can, I submit, have no existence. Thus the grade of organization is potential energy gained for the individual by inheritance, since it is thus placed in a position of mechanical advantage with regard to gravity as definite as is the advantage of a head of water. It is in part this potential energy which enables the individual to manifest the kinetic energy of its own muscular effort, since in flight, for instance, an animal is projected upwards against gravity. Now, in the manifestation of kinetic energy, the heat, or whatever the force was which did the work against gravity, is obviously converted into motion; hence the difficulty found by Prof. Owen, in animals being sometimes warmer in rest than in motion, is met. And it may be presumed that it is as true of organic as of inorganic matter, that it is arrest of motion which develops heat; but in the case of the increase of temperature of the incubating Boa and the bird, the heat is so obviously due to the arrest of radiation by the contact of the parent's body with the eggs, which are acquiring an independent heat of their own, that it should occasion no more astonishment than that we are warmer with a fire than without one, and certainly should not have

been given as evidence that heat is not dependent upon energy; for here the heat is not generated but only conserved.

In ascending from the lower to the higher groups of the vertebrate province, increase in temperature is found to be associated with perfection of the respiratory system, and not necessarily with a non-conducting covering; and it is to superior respiration and its concomitant superior nutrition that must be attributed, as a chief cause, the grades of organization which divide vertebrate animals into classes. Any modification of the skeleton which throws light on the respiratory function is therefore of great classificational value in palæontology. The avian type of skeleton differs typically from that of other classes in having the respiratory organs prolonged into the bones. It is stated by a good observer, and is, I believe, well known, that if the larynx of a bird be tied, and the humerus broken, and the fractured surface exposed, the animal will breathe feebly through its humerus. Similarly to birds, and unlike all other animals, the bones of Pterodactyles show pneumatic foramina, which, so far as comparable, are placed, as in birds, in the limb-bones and vertebral column. I draw the conclusion, therefore, that the foramina are evidence in Pterodactyles that the respiratory organs extended into the bones; and seeing that from a bird's bone with this pneumatic structure we infer for the animal hot blood and a peculiar kind of respiration, so there is no choice but to make the same inferences from the pneumatic bone of a Pterodactyle, since no other relation of the pneumatic structure is known; it is a law of limb-bones and vertebræ to which there is no exception. To attribute any function to the pneumatic foramina other than that seen in birds would be to discard the only known clue to their interpretation. Prof. Owen admits that the bones are filled with air, and that therein they resemble those of birds; but he does not intimate where the air came from, and makes no mention of the respiratory relation of the foramina, which accordingly have no physiological function assigned to them. And Prof. Owen only finds that "the legitimate if not sole inference from the admission of air to the bones is that it contributes to perfect the mechanism of flight," which is supposed to be achieved by air replacing dense osseous tissue, and so making the bones lighter. If that were the sole or legitimate function, it ought to be manifested in the crocodile and turtle, where the quadrate bone is excavated for a tympanic air-cell; and in the skulls of the Elephant and many mammals air is admitted to several bones, but this justifies no such inference as that drawn by Prof. Owen.

Hence I conclude that Prof. Owen's philosophy will not

bear investigation, and that it cannot replace the old paths of physiology.

It also seems to me that Prof. Owen has done injustice to his subject by ignoring the work of others, by appropriating their discoveries as his own, and by so representing their labours as to asperse their reputation.

Thus, in the 'Comparative Anatomy of the Vertebrates,' vol. i. p. 176, Prof. Owen, in an unobtrusive way, essentially claims the discovery of the pneumatic structure of Pterodactyle bones, referring to his later monographs on Pterosaurs. In this monograph on *Dimorphodon* the claim is essentially repeated (p. 79), reference being made to the Palæontographical volume for 1851 for the demonstration that the larger bones of Pterodactyles were filled with air, while the same character is here inferred for *Dimorphodon*. Prof. Owen has quoted freely from the introduction to Von Meyer's 'Reptilien aus dem lithographischen Schiefer,' 1859; but he has omitted to quote or mention the passage in which Von Meyer claims to have made this discovery in 1837, and gives Prof. Owen credit for having subsequently made known English specimens which show the same character. On turning to the 'Jahrbuch für Mineral.' 1837, p. 316, I find the omission was not made because Von Meyer's claim was groundless; for there is printed this passage:—"Further, I must communicate to you that by examining many united bones of Pterodactyles from the Lias of the neighbourhood of Bayreuth, I have discovered that some of them are furnished with air-holes, like certain birds' bones, whereby an affinity with birds in a new way is given to them."

Then with regard to the name Pterosauria, I am not aware that it has claim to an earlier date in England than 1841. Yet referring to Von Meyer, he quotes Prince C. L. Bonaparte as having named the order Ornithosaurii at the same time. On looking into the matter, I find that in the "Nuovi Annali delle Scienze Naturali, Bologna,' Sept. 24, 1840, vol. iv. p. 91, and previously in 1838, vol. i. p. 391, Bonaparte not only invented the name, but adopted the ordinal group suggested by Von Meyer in 1830, and placed it above all other reptiles, in immediate sequence to birds,—a result possibly due to Von Meyer's discovery of 1837. Accordingly Prof. Owen's name has no claim to usage, either on the ground of priority or fitness, and I have therefore used the name Ornithosauria*.

* Since this was written, six months ago, I find that, in 'Das Thierreich,' vol. ii. part 2. p. 23, published at Darmstadt in 1836, Dr. J. J. Kaup introduced the Pterosaurii as the second order in his second stem of Amphibia. And earlier still (Nouv. Ann. Muséum, 1835, vol. iv. p. 238,

Finally, there are two passages of a kind that are rarely seen in a scientific monograph, one reflecting on Prof. Huxley, the other reflecting, I think, upon myself. The former passage is as follows:—"The tyro, fresh from the lecture-room of his physiological teacher, ambitious of soaring into higher regions of biology than were opened to him at the medical school, impressed with the relations of active locomotion to generation of animal heat, may be pardoned for inferring that the amount of work involved in sustaining a Pterodactyle in the air would make it, physiologically, highly probable that it was a hot-blooded animal. But a competent friend, finding him bent on rushing with such show of knowledge into print, would council him to provide himself with a thermometer adapted to the delicate testing of the internal heat of small animals. So provided, if he should chance to beat down a chafer in full flight, the experiment, made with due care and defence of the fingers guiding the instrument, would teach him how fallacious would be the inference that, because an animal can fly, it must, therefore, be hot-blooded," &c. &c.

The other passage, referring seemingly to myself, concludes as follows:—"An argument in favour of Avian affinity from the joint-structures could only be propounded by one not gifted with the judgment needed to deal with problems of this nature." These passages I leave to the consideration of others. Yet I would express my conviction that it did not fall within the province of the Palæontographical Society to publish such matter.

XI.—*On four new Species of Birds from China.* By Robert Swinhoe, F.Z.S.

Ephialtes glabripes, sp. nov.

Similar to *Eph. semitorques* (Temm. & Schleg.) of Japan,

De Blainville introduces a scheme of Vertebrates as having been given in his lectures, in which *Pterodactylia* is given as the third class of Vertebrata, intermediate between Birds and Reptiles. I regret not having been aware of this fact at an earlier period, since the name Pterodactylia is in all ways preferable to other names. As, however, it has hitherto remained unknown, I am not prepared to adopt it now, the name Ornithosauria being already in use. De Blainville adds this observation:—"Cette classe ne contient encore que le genre Ptérodactyle connu seulement à l'état fossile, et que nous pensons n'être ni un mammifère de la famille des chauve-souris, comme Sœmmering l'a pensé, ni même un reptile proprement dit, comme G. Cuvier l'a dit, mais un être faisant le passage des oiseaux aux reptiles, et dont le système épidermique n'était peut-être pas squameux."

but differs from it in having the toes always bare, instead of feathered along their upper surfaces as in that species.

Inhabits South China and Formosa.

Ephialtes Hambroecki, sp. nov.

A robust rufous little species, with very long feathery horns, and the bill nearly hidden by the long bristle-ending feathers of the lores. Wing much graduated, the fifth quill the longest; tail comparatively long, somewhat graduated. Tarsi bare just above the junction with the toes; toes covered with minute, oblong, prominent scales, except at the insertion of the claws, they are broad and transverse.

Upper parts, wings, and tail chestnut-brown, blotched and mottled with black on the head and hind neck. On the upper back the feathers are banded with reddish white, forming a distinct halter-mark across the shoulders, the white being succeeded by a border of black blotches. Some of the scapulars have their outer webs pure white; the carpal edge and a patch close to it also white. Under neck reddish white waved with black, with a few close-lying spots of the same forming a patch on each side. Sides of breast deep rufous mottled with black; flanks, vent, and tibiæ light rufous, finely mottled and occasionally streaked with brown; centre of belly pure white. Quills blackish brown on inner webs, chestnut-brown on outer, mottled with black and banded with rufous cream-colour. Tail deep rufous, banded and mottled with black.

Length about 7 inches; wing 5·8, the first primary falling 1·8 short of tip; tail 3·5.

This small owl, which really has closer affinity for the *Ephialtes-lempiji* (Horsf.) group than for *Ephialtes japonicus* (T. & S.), I mistook for the latter (see 'Ibis,' 1865, p. 348, and 1866, p. 307). It has occurred only in Formosa.

I name this species in remembrance of the celebrated Dutch missionary who was murdered by the pirate chief on the conquest of Formosa.

Cuculus Michieanus, sp. nov.

A large thick-billed cuckoo, to be at once distinguished by its upper parts being brown glossed on the mantle with purplish pink. Head and hind neck deep bluish grey; under neck lighter. Breast and belly cream-colour, banded with broad blackish-brown bars; a few bars also occur on the lower tail-coverts. Under wings marked with white as ordinary. Tail with a broad black subterminal bar, tipped with cream-colour.

Length about 13·5; wing 8·3; tail 6·75; bill, from forehead ·9, depth at base ·35.

Iris brownish yellow; rictus and eyelids bright yellow. Upper mandible and tip of lower black, rest of lower mandible light green; inside of mouth yellow. Legs orange-yellow; claws brown, with black ridges.

This species stands midway between the true cuckoos and *Hierococcyx*. We found it abundant at Szechuen (Western China) in May. It is very noisy, flying excitedly from tree to tree, uttering its loud notes, which may be syllabled *cóló-tóló*.

To Mr. Alexander Michie of Shanghai, for the kind assistance he gave me in the pursuit of natural history on the Upper Yangtsze, I dedicate this species.

Henicurus leucoschistus, sp. nov.

Similar to the *H. schistaceus*, Hodgs., of India; differs in having the bill straighter along the culmen, and the gonys more ascending. In its markings it wants the white tips that adorn the first to the sixth primaries of the Indian bird; and its under wing, instead of having the bases of the primary quills white, commencing on the second quill and increasing inwards, has the basal third of the quills edged on the inner web with white, commencing with the fourth quill.

Inhabits the hills of Southern China.

XII.—*Notes on the Skull of* Balæna marginata, *the type of a new Genus*, Neobalæna. By Dr. J. E. GRAY, F.R.S. &c.

IN the essay on Whales published in the 'Voyage of the Erebus and Terror' I established a species of true Whalebone-Whale on three examples of whalebone which I had received from Western Australia, believing it to belong to the same genus as the Greenland Whale (*Balæna*), as the whalebone was of long slender shape, and of a very fine texture, with a large quantity of enamel, which is a peculiarity of the baleen of that genus. Sir George Grey, the late Governor of New Zealand, has obtained the skull of *Balæna marginata* from the island of Kawan, New Zealand, and has presented it to the Museum at Wellington. Dr. Hector has given figures exhibiting four views of this skull in the 'Transactions and Proceedings of the New-Zealand Institute' for 1869, vol. ii., which was issued in April 1870. These figures show that the whale, which has long, slender, and fine-textured whalebone or baleen like that of the Greenland Right Whale, forms a very different genus from the restricted genus *Balæna*. The brain-cavity forms a much larger part of the skull; the beak is much

shorter and broad at the base, gradually tapering to a point in front; and the lower jaw bones are thin, compressed, and high, with the upper edge dilated and inflexed the greater part of their length, and the lower edge similarly dilated in the front part or chin.

I propose for this animal the name *Neobalæna*; and it may be thus characterized:—

NEOBALÆNA.

Skull rather depressed; brain-cavity nearly as long as the beak, depressed, much expanded on the sides, with a very deep notch on the middle of each side over the condyles of the lower jaw, and with a subtriangular crown-plate. The nose as broad as the expanded brain-cavity at the base, regularly attenuated to a fine point in front, and slightly arched downwards. Lower jaw laminar, compressed, high; the upper edge thin, and inflexed the greater part of its length, erect in

Fig. 1.

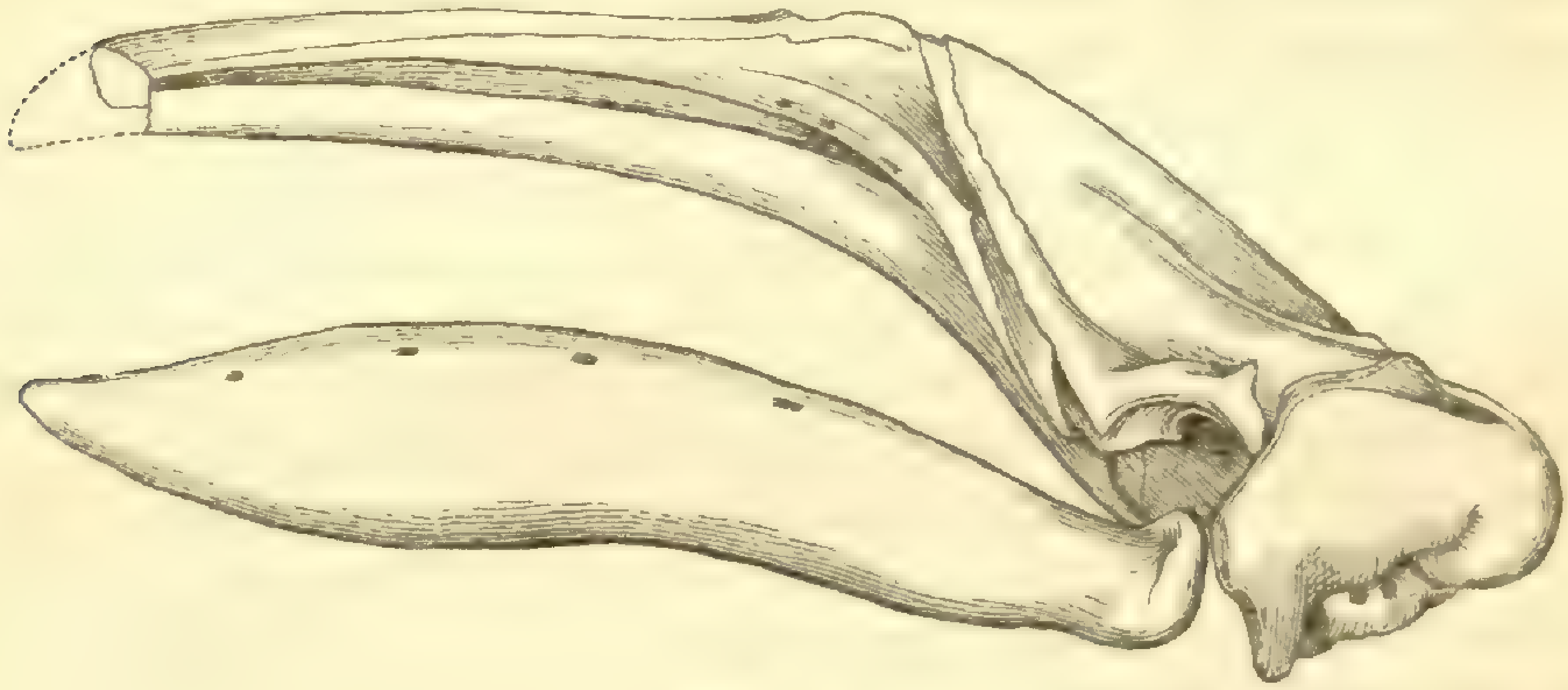
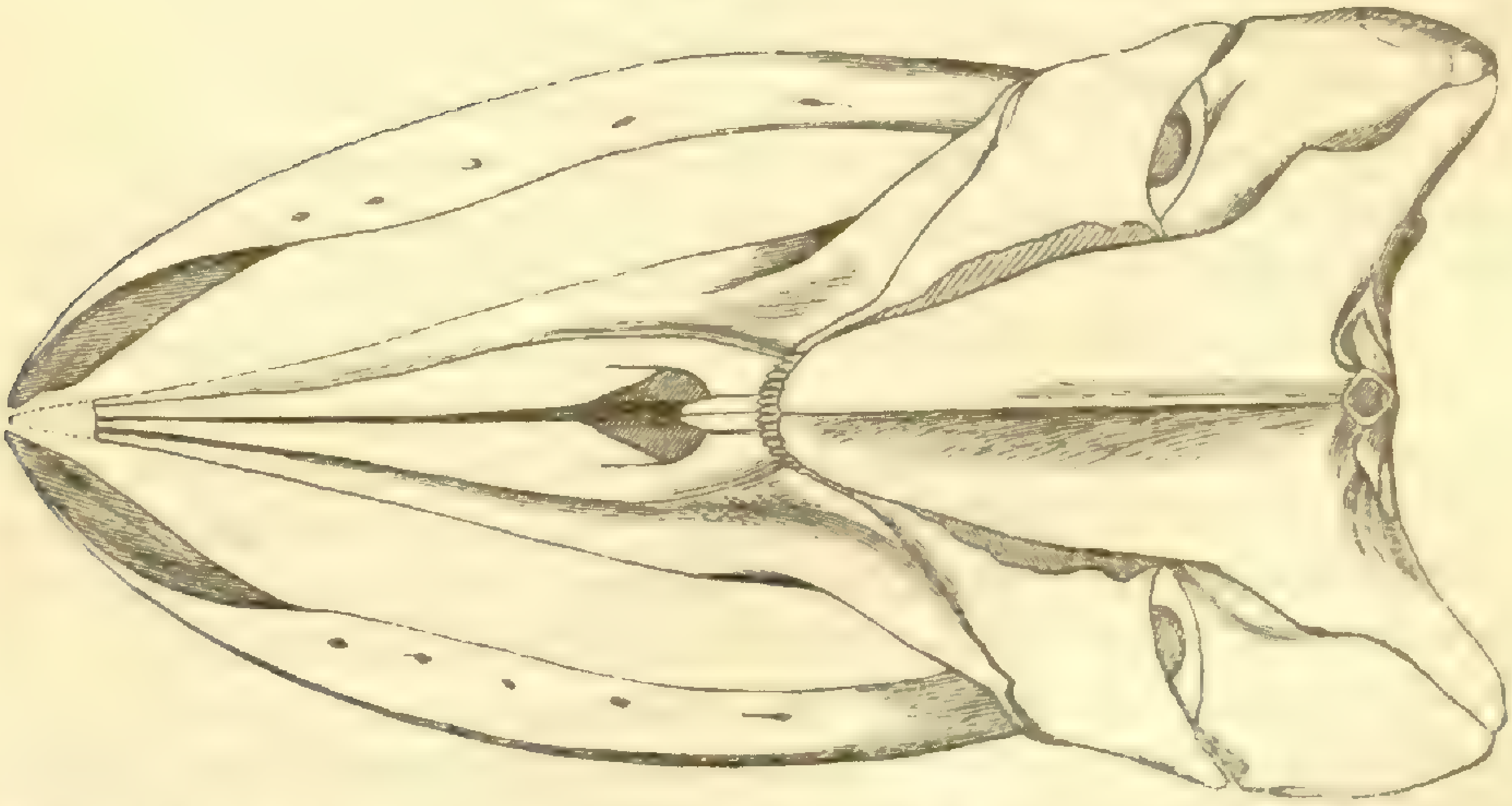


Fig. 2.



Figs. 1 & 2. Side view and top view of the skull of *Neobalæna marginata*, from Dr. Hector's figures.

front; the lower edge inflexed in front, the rest of the edge being simple. The baleen elongate, slender, several times as long as broad, with a fringe of a single series of fine fibres; enamelled surface smooth and polished, thick.

Neobalæna marginata.

Balæna marginata, Gray, Cat. Seals & Whales Brit. Mus. p. 90; Hector, Proc. & Trans. of the New-Zealand Institute, 1869, t. 2 *b*. f. 1–4; Ann. & Mag. Nat. Hist. 1870, vol. v. p. 221.

Hab. New Zealand.

This is interesting, as showing that the true *Balæna* or Right Whale of the North Sea and that of the South Sea are each a peculiar genus.

The width and general form of the beak of the skull is somewhat like the beak of some of the Finner Whales; but it does not at all justify Mr. Knox's idea that *Balæna marginata* is a Finner. But this difference of skull makes us more anxious to have the description of the entire animal and its skeleton, as the animal may prove to be the type of a new family of Whales, between the true Whales and Finners.

This pigmy whale, which is not more than 15 or 16 feet long, is a representative in the Southern Ocean of the gigantic Right Whale of the Greenland seas. It has the most beautiful, the most flexible, most elastic, and the toughest whalebone or baleen yet discovered; and if it were of larger size, it would fetch a much higher price than the whalebone of the Greenland whale, the latter being three or four times the value of the brittle coarse whalebone of the *Eubalæna* or Right Whales of the Southern and Pacific Oceans. The trade of the Continental nations being chiefly confined to their colonies, or their merchants obtaining the whalebone that is used in their manufactures second-hand, there are not in the market the varieties of whalebone and finner-bone which we have in this country, where the whalebone and finner-bone from different localities bear each a different value. This perhaps explains why the Continental zoologists (as Eschricht) who have paid attention to the structure of whales have not paid sufficient attention to the characters afforded by the shape, structure, and colour of this substance, to which I called their attention more than twenty years ago, and showed its value as a character for distinguishing the genera and species. It has been a fertile subject of reproach to me that I established some species on the characters afforded by this substance; but I need only quote, as a proof of the little attention M. Gervais has paid to this part of my work, that, in his book on the anatomy of whales, now in progress, after saying that I have established

the species *Balæna marginata* on three blades of whalebone, he says I have called it *Eubalæna marginata*—thus confounding it with the whales with brittle and coarse whalebone, whereas the chief reason that induced me to consider the blades to belong to a distinct species was their very fine and tough structure. The accuracy of the determination is now proved by the very different form of its skull from that of any other known whale. In the same manner, the *Physalus antarcticus*, also established on finner-fins or baleen imported from New Zealand, has been proved to be a very distinct species of that genus, named Sulphur-bottoms by the whalers.

XIII.—*On a Collection of Birds from China and Japan.* By R. B. Sharpe, F.L.S., Libr. Z.S., &c. With Notes by the Collector, Robert H. Bergman.

I have lately received from my friend Mr. Bergman a small collection of birds which he has formed during his leisure time in the course of his cruises between China and Japan. This is the first consignment he has transmitted to me; and although the birds sent are none of them very rare, I think it advisable to place on record the very interesting notes which Mr. Bergman has added on the habits of the species noticed by him; and for the trouble taken in this matter he deserves all praise. I shall hope from time to time to contribute further notes on Chinese birds as they are sent home to me by the present collector. The nomenclature employed is that adopted by Mr. Swinhoe in his 'Catalogue of the Birds of China' (Proc. Zool. Soc. 1863, p. 259); and I have availed myself of that gentleman's presence in England to obtain his assistance in the identification of some of the species.

1. *Turdus Naumanni.*

Turdus Naumanni, Temm.; Swinh. P. Z. S. 1863, p. 280.

No. 15. Shot at Shanghai, Jan. 7, 1870. Legs, eyes, and beak black. Generally found in pairs in the villages.—*R. H. B.*

2. *Turdus fuscatus.*

Turdus fuscatus, Pall.; Swinh. P. Z. S. 1863, p. 280.

No. 2. Thrush, caught in the rigging of the S.S. 'Cadiz,' going up the Yangtze river to Shanghai, Nov. 28th, 1869. Legs, beak, and eyes black. Common in North China and Japan.—*R. H. B.*

3. *Petrocincla manillensis.*

Petrocincla manillensis (Bodd.); Swinh. P. Z. S. 1863, p. 281.

No. 24. Grey Thrush, shot at Nagasaki, Feb. 1, 1870. Bill, eyes, and feet black.—*R. H. B.*

4. *Ruticilla aurorea.*

Ruticilla aurorea, Pall.; Swinh. P. Z. S. 1863, p. 291.

No. 23. Redstart, shot at Nagasaki, Feb. 1, 1870. Eye black; bill and legs brown. This species appears to be very numerous at Nagasaki, as four or five pairs were seen in one morning flying about the plum-trees, which were just in blossom.—*R. H. B.*

5. *Lanius schach.*

Lanius schach (Gm.); Swinh. P. Z. S. 1863, p. 286.

No. 7. Butcher-bird, shot at Shanghai, Dec. 26, 1869. Beak and legs black; eyes dark brown, with black pupils. These birds are fond of sitting on the uppermost boughs of trees or in any elevated position. They utter a peculiar cry, which, however, is not unmelodious.—*R. H. B.*

6. *Lanius bucephalus.*

Lanius bucephalus, Schl.; Swinh. P. Z. S. 1863, p. 287.

No. 17. Shot at Yokohama, Jan. 22, 1870, on the outskirts of a wood. Stomach contained several small beetles. Bill and legs dark brown; eyes black.—*R. H. B.*

7. *Motacilla ocularis.*

Motacilla ocularis, Swinhoe; Swinh. P. Z. S. 1863, p. 273.

No. 14. Water-Wagtail, shot at Shanghai, Jan. 7, 1870. Beak, legs, and eyes black.—*R. H. B.*

8. *Emberiza rustica.*

Emberiza rustica (Pall.); Swinh. P. Z. S. 1863, p. 301.

Kobe, Japan, Jan. 27, 1870.—*R. H. B.*

9. *Emberiza ciopsis.*

Emberiza ciopsis, Bp.; Swinh. P. Z. S. 1863, p. 300.

Japan.

10. *Chlorospiza kawariba.*

Chlorospiza kawariba (T. & S.); Swinh. P. Z. S. 1863, p. 299.

Nos. 21 & 22. Cock and hen Greenfinch, shot at Kobe, Japan, Jan. 27, 1870. Eye black; bill and legs brown. Several flocks of these birds were seen about Kobe and Nagasaki.—*R. H. B.*

11. *Passer montanus.*

Passer montanus, Linn.; Swinh. P. Z. S. 1863, p. 299.

No. 3. Shot at Kobe, Japan, Nov. 30, 1869. Very common throughout Japan.—*R. H. B.*

12. *Microscelis amaurotis.*

Microscelis amaurotis (T. & S.); Swinh. P. Z. S. 1863, p. 334.

No. 29. Yokohama.

No. 18. Shot at Yokohama, Jan. 22, 1870. Beak and legs brown; eyes grey, with black pupils. The stomach contained several kinds of berries.—*R. H. B.*

13. *Sturnus cineraceus.*

Sturnus cineraceus, T. & S.; Swinh. P. Z. S. 1863, p. 301.

No. 12. Starling, shot at Shanghai, Jan. 8, 1870. Legs yellow; bill yellow, terminal half black; eyes black.—*R.H.B.*

14. *Acridotheres philippensis.*

Acridotheres philippensis (Temm.); Swinh. Ibis, 1867, p. 387.

No. 11. Mynah. Shot at Shanghai, Jan. 8, 1870. Legs and beak light yellow; eyes yellow, with black pupils. The habits of these birds are very similar to those of the common Starling. They whistle very well, and can be taught to talk. —*R. H. B.*

15. *Cyanopica cyanea.*

Cyanopica cyanea (Pall.); Swinh. P. Z. S. 1863, p. 304.

No. 6. Shot at Shanghai, Dec. 26, 1869. Beak, eyes, and legs black. These birds are found in flocks in the bamboo-groves about the villages in North China. They have the appearance of paroquets when flying, but have a harsh cry, like a magpie or jay. Their food appears to consist of worms, grubs, and beetles.—*R. H. B.*

16. *Pica media.*

Pica caudata, var. *media*, Swinh. P. Z. S. 1863, p. 303.

No. 9. Magpie, shot at Shanghai, Jan. 7, 1870. Eyes, beak, and legs black. Very common about Shanghai, and may be seen in flocks of fourteen and fifteen together.—*R. H. B.*

17. *Lycus dauricus.*

Lycus dauricus (Pall.); Swinh. P. Z. S. 1863, p. 304.

No. 10. Jackdaw, shot at Shanghai, Jan. 8, 1870. In flocks.—*R. H. B.*

18. *Buteo japonicus.*

Buteo japonicus, Schl.; Swinh. P. Z. S. 1863, p. 260.

No. 19. Shot on a tree at Yokohama, Jan. 22, 1870, while devouring a cocoon. Eyes yellow, with black pupils. Legs bright yellow; beak bluish black.—*R. H. B.*

19. *Tinnunculus japonicus.*

Tinnunculus japonicus, Schl.; Swinh. P. Z. S. 1863, p. 261.

No. 1. Hawk, shot at Foochow, Nov. 1, 1869. Eyes black, eyelids yellow; legs bright yellow; beak bluish black, yellow at the base.—*R. H. B.*

20. *Circus cyaneus.*

Circus cyaneus, Linn.; Swinh. P. Z. S. 1863, p. 261.

No. 8. Shot on the banks of the river Yangtze at Shanghai, Jan. 6, 1870. Legs light yellow; eyes yellow, with black pupils; beak bluish black and yellow at the base. Stomach contained only a few feathers.—*R. H. B.*

21. *Circus æruginosus.*

Circus æruginosus, L.; Swinh. P. Z. S. 1863, p. 332.

No. 26. Shot in a swamp at Yokohama. Eyes yellow, with black pupils; legs yellow. I have seen this bird several times catch fish in a large lake.—*R. H. B.*

The specimen sent by Mr. Bergman is apparently a female Marsh-Harrier, but in a peculiar stage of plumage. Mr. Gurney, to whom I showed the bird, thought it might belong to *Circus spilonotus*; but on conferring with Mr. Swinhoe, who is thoroughly acquainted with the last-named species, the latter gentleman decided that it was only a female of *Circus æruginosus*. The female *C. spilonotus*, though closely allied to the common Marsh-Harrier, may be distinguished by its generally paler coloration, and by the light upper tail-coverts, as depicted in the 'Ibis' for 1863, pl. 5.—*R. B. S.*

22. *Alcedo bengalensis.*

Alcedo bengalensis, Gm.; Swinh. P. Z. S. 1863, p. 269.

No. 13. Kingfisher, shot at Shanghai, Jan. 8, 1870. Legs dark yellow, almost red; eyes and beak black.—*R. H. B.*

23. *Botaurus stellaris.*

Botaurus stellaris, Linn.; Swinh. P. Z. S. 1863, p. 320.

No. 20. Bittern, shot in a reed-swamp at Yokohama, Jan. 24, 1870. Eyes yellow, with black pupils; legs light green;

beak light brown. Whilst skinning this bird, I was astonished to find a quantity of white worms in the muscles of the thigh. I examined the rest of the body and the stomach, but did not find any elsewhere.—*R. H. B.*

24. *Mergus serrator.*

Mergus serrator, Linn.; Swinh. P. Z. S. 1863, p. 323.

No. 25. Shot at Nagasaki, Feb. 11, 1870. Beak and legs red; eyes yellowish brown. Stomach contained half-digested fish.—*R. H. B.*

25. *Fuligula marila.*

Fuligula marila (Linn.); Swinh. P. Z. S. 1863, p. 324.

No. 4. Duck, shot at Yokohama, Dec. 16, 1869. Legs and beak bluish black; eyes yellow, with black pupils.—*R. H. B.*

XIV.—*List of Coleoptera received from Old Calabar, on the West Coast of Africa.* By Andrew Murray, F.L.S.

[Continued from p. 56.]

Helymæus, J. Thoms.

Helymæus rufiventris.

Closteromerus rufiventris, Chevr. Rev. et Mag. d. Zool. 1855, p. 514.

Alatus, niger; capite punctato; thorace transversim plicato; scutello bifido, viridi; elytris cyaneo-viridibus, albo setosis, medium versus subcoarctatis, ultra modice ampliatis et convexis, apice truncatis et singulatim bidentatis, pone scutellum seriebus tribus vel quatuor punctorum plus minusve impressorum; pectore crebre punctato, atro, albo villoso; abdomine rufo; femoribus valde clavatis.

Long. $3\frac{1}{2}$ lin., lat. $1\frac{1}{4}$ lin.

As black as ebony. Head narrow, elongated, vertical in front, very finely and distinctly punctate. Thorax cylindrical, gibbous above, with some silky white pubescence on the sides; above feebly transversely wrinkled. Scutellum triangular, bifid. Elytra blue or greenish blue, advanced a little obliquely at the shoulder, slightly narrowed towards the middle, broader and convex behind it, truncated and bidentate at the apex of each elytron, and bearing some white hairs; their surface is very finely rugulose; and under a strong lens they show a series of small punctures, which towards the scutellum become strong and irregular in size and form; the second internal series is placed in a groove. Breast coarsely punctate, deep black, clothed with a white and silvery down. Abdomen

smooth, red, of five segments, the first very large and bearing some punctures and wrinkles. Pygidium subconic, granular. Legs black; thighs strongly and abruptly swollen.

Described by M. Chevrolat from specimens communicated to him by Mr. Thomas Gray. In the British Museum.

M. Chevrolat described this as a species of *Closteromerus*; but it seems either to be a new genus or to belong to Thomson's genus *Helymæus*, which has the elytra concolorous and truncate at the apex as in this, instead of being decorated with yellow spots or bands and entire at the apex as is the case with *Closteromerus*. Not to multiply genera, I have placed it in *Helymæus*, although in some points, as its wrinkled thorax, it does not wholly agree with it.

Phrosyne (Pascoe in litt.), nov. genus.

Genus affine *Euporo*, differt ab illo antennis corpore brevioribus (et maribus et fœminis) versus apicem incrassatis, articulo tertio longitudine art. 4–6; thorace medio vage fortiter punctato, antice et postice breviter constricto; femoribus posterioribus elytrorum apicem haud attingentibus.

Lacordaire points out that the genus *Euporus* as it stands at present includes two distinct forms, which ought to be separated as genera, the first of which is represented by the *Euporus strangulatus* of Serville, with long antennæ and hind thighs extending beyond the body, the second by the *Euporus viridis* of Serville and the species (*Eu. brevicornis*, Fab.) which follows. *Eu. strangulatus*, standing first among the species described by Serville under *Euporus*, must be reckoned the typical example of that genus; and in dividing the genus into two, that name must be reserved for it and the species of a similar type. For the other form I adopt Mr. Pascoe's MS. name *Phrosyne*, under which the species in question have long stood as a section apart in that acute entomologist's cabinet.

Phrosyne brevicornis.

Euporus brevicornis, Fab. Syst. Eleuth. ii. p. 289.
—— *disparilis*, Chevr. Rev. et Mag. d. Zool. 1856, p. 571?
—— *splendidicollis*, Thomson.

Læte viridis; mandibulis antennisque nigris cyaneo micantibus; capite creberrime punctato, breviter sulcato; thorace antice recto, plicato, postice constricto, basi bisinuato, medio globoso et fortiter punctato, lateribus rotundatis; scutello triangulari, aurato; elytris thoracis latitudine, viridi-obscuris, vittis duabus longitudinalibus, una mediana, altera suturali, pectore abdomineque viridi-aureis, glabris, minutissime

punctatis; ano producto, truncato; pedibus nigris; femoribus quatuor anticis medio rubris.

Long. 5–5½ lin., lat. 1–1½ lin.

Very near *Euporus viridis*, Serv. (*madagascariensis*, Dej.), but narrower, of a fine golden green above, and coppery below. Head narrow, sinuate alongside the eyes, covered by a close punctation, longitudinal groove disappearing in front. Palpi black. Mandibles of an indigo-blue, passing into blackish. Antennæ of the same colour, short, thickened towards the apex, grooved on the outer side, with the third article very long, bent and slightly angular at the top. Thorax straight in front, transversely wrinkled on the anterior third, with a smooth space neither punctured nor wrinkled behind this, constricted and wrinkled behind and bisinuate at the base, rounded above and on the sides, and coarsely irregularly punctate, the posterior part of the dorsal space being partially impunctate. Scutellum triangular, golden. Elytra finely shagreened, dull blackish green, shining on the shoulder, and each with two narrow lines of a more delicate green, one on the middle of the elytron, and the other on the suture. Breast and abdomen polished golden copper and very indistinctly punctate. Legs of an indigo-blue, passing into blackish; thighs abruptly and much thickened near the knees, four anterior thighs red on the swollen part; soles of the tarsi covered with a thick yellowish brush of hair.

Appears to be rather common at Old Calabar.

I can find no difference between M. Chevrolat's description of *Eu. disparilis* and *Eu. brevicornis* but that the male differs from the female by having all the thighs blue-black; the females seem to correspond exactly. It may be that this is nothing more than an accidental variation; and I treat it as such, with a point of doubt, in the meantime. Should it not be so, I am then inclined to think that M. Chevrolat has had under his eyes the females of *Eu. brevicornis* and the male of a new species (*disparilis*), the more so that he does not include *Euporus brevicornis* in his list, although it is one of the commoner species at Old Calabar, and he certainly had it from me.

Xystrocera, Serv.

1. *Xystrocera femorata*, Chevr. Rev. et Mag. d. Zool. 1855, p. 282.

Ruge punctata, viridis; femoribus, pectore abdomineque rufis; mandibulis, antennis (corpore longioribus, primo articulo rufo), tibiis tarsisque nigris.

Mas. Thorace globoso, magno, creberrime punctulato, plagis

quinque aureis. Elytris unicostatis, ad apicem attenuatis, singulatim apice rotundatis.

Fœm. Thorace minuto, subrotundato, remote asperato; elytris amplis, parallelis, bicostatis.

Long. 11–12 lin., lat. 2–3 lin.

Green, with the usual subrugose texture of *Xystrocera.* Thorax globose, with smooth shining spots. Underside rufous. Mandibles, antennæ (first article excepted, which is rufous), and legs black, except the thighs, which are reddish.

Not very rare.

This genus belongs to the original Indo-African element. The species are confined to Africa and the Indo-Malayan district, with a few wanderers over the borders into the nearest parts of Australia.

2. *Xystrocera cyanella*, Chevr. Rev. et Mag. d. Zool. 1855, p. 545.

Alata, cyanea vel viridi-cyanea; mandibulis, oculis, antennis (scobinatis) pedibusque (femorum basi excepta) nigris; corpore infra nigro vel fusco-brunneo, segmentorum marginibus dilutioribus; scutello lævigato, reflexim marginato, violaceo; thorace medio lævigato; elytris transversim rugosis, pectore lanugine alba induto.

Long. 5 lin., lat. 2 lin.

Of a very brilliant blue and bluish green at the top of the head and base of the elytra. Head with a very fine black groove in the middle, covered with asperities. Palpi (whitish at the truncature), mandibles, eyes, and antennæ black, the latter bearing a great many rough small tubercles, making the surface like a file. Thorax a little broader than long, rounded on the sides, with the anterior margin straight and the posterior bisinuated, broadly channelled on each side, smooth, glabrous, and of a fine brilliant blue above, greenish on the lower sides. Scutellum triangular, elongated, margined, smooth, violet or brown with a violet tinge. Elytra a little broader than the thorax, rounded and smooth on the top of the shoulder, almost parallel, only a little wider towards the extremity, which is rounded. Their surface has the rough punctate wrinkling which is characteristic of the genus. Legs and body below deep black; sides of the metasternum clothed with a white pubescence.

Apparently rare, only one or two specimens having been received out of many *envois*. In my collection.

3. *Xystrocera marginipennis.*

Ruge punctata, flavo-ferruginea; mandibulis, oculis, antennis

(primo articulo rufo-fusco) nigro-brunneis; thorace marginibus antico et postico lateribusque et subtus violaceo-brunneo; scutello punctato; elytrorum lateribus viridibus; abdomine piceo-fusco; pedibus (femorum clava plus minusve ferruginea) nigris; mesosterno et metasterno subvillosis; thorace punctato, medio parum lævigato.

Long. 10½ lin., lat. 3 lin.

Texture, as usual in *Xystrocera.* Flavo-ferruginous, with the following exceptions:—the mouth, eyes, antennæ (first article excepted, which is dark ferruginous) are blackish brown; the thorax below and on the sides and along the anterior and posterior margins violet-brown; the margins of the elytra green, and a slight tinge of green in some lights extending over the flavous surface of the elytra. The abdomen blackish brown, and the legs black, except on the club of the thighs, which is reddish, especially on the anterior legs. The antennæ are coarsely scabrous, the head coarsely punctate above, more freely on the sides, below glabrous, but with one or two faint wrinkles. The thorax widest in the middle, and nearly equal in breadth in front and behind (if any thing, widest in front), rather finely punctate, except in the middle, where there is a narrow smoothish space, slightly shining in front and behind. The anterior and posterior margins nearly straight, slightly raised; the posterior margin edged and reflexed, and extending back in a lobe in the middle; the disk slightly foveolated on each side of the middle, and again in a curved depression towards the sides and also on the sides, leaving a slight trace of two elevations on the side—one in the middle and another in front. Scutellum rather large, and coarsely and distinctly punctate. The elytra coarsely rugosely punctate. Mesosternum and metasternum villose.

Rare. One specimen in my collection.

4. *Xystrocera Pascoei.*

Supra viridis; elytris parum flavo intermixtis; scutello et subtus flavo-rufis; tibiis tarsisque fuscis. Affinis *X. marginipenni*, differt colore, thorace magis punctato et foveolato; scutello minus, elytris fortius punctatis; femoribus minus clavatis.

Long 9 lin., lat. 2½ lin.

Allied to the preceding species, but distinguished by the colour, which is green above and flavo-rufous beneath. The thorax in the preceding species is pale above and darker beneath, and the abdomen blackish brown, and only the mesosternum and metasternum flavous, whilst here the abdomen is

of the same colour as the metasternum. The thorax is more coarsely punctate, and has deeper foveæ, and one immediately in front of the scutellum; the sides have two more decided tubercles; the scutellum is not so much punctate; the elytra are more coarsely punctate; the suture rufous, and indications of the same colour shine through the green on the rest of the elytra, except on the sides, which are decided green. The legs have the clubs of the thighs less pronounced, and are flavo-rufous instead of black, the base of the thighs being slightly fuscous, and the tibiæ and tarsi blackish brown.

I have seen only one specimen: it formed part of one of the later *envois* from Ikoneto. In my collection. I have named it in honour of my friend Mr. Pascoe, who has done so much to elucidate the family on which I am now engaged.

Œme, Newm.

Œme nigrita, Pl. II. fig. 1. Chevr. Rev. Zool. 1855, p. 183.

Fortiter et crebre punctata, nigra, nitida, pube rutila partim induta; antennis pedibusque validis; capite magno, rotundato, rugoso, antice profunde medioque supra vix sulcato, antennis articulis undecim planis elongatis; thorace brevi, transverso, subrotundato, lateribus subangulato, antice recto (dein stricto), postice leviter bisinuato et marginato, in longitudine postica sulcato; elytris conjunctim rotundatis, ad medium unicostatis; abdomine segmentis quinque.

Long. 10 lin., lat. 3 lin.

The figure, by M. Migneaux, renders any further descriptive remarks unnecessary.

Rare. One or two specimens only.

Until the discovery of this species, the genus contained nothing but American species, mostly Brazilian, which, instead of black, are of a bright reddish yellow.

Œdenoderus, Chevr.

The history and position of this genus seem to me to furnish a happy illustration in support of the importance of surface-texture and, even, colour on the one hand, and of geographical distribution on the other, as a key to the discovery of natural affinities.

Among the species which I received from Old Calabar, and intrusted to M. Chevrolat for description, was a livid testaceo-ferruginous insect, that looked something like a *Callidium*. M. Chevrolat described it as such, with a point of doubt, under the name of *Callidium? sphæricolle*. He said, "The

only specimen which I possess being in a very bad condition, I have not been able to study this species completely. It ought, without doubt, to form a new genus." Better specimens of another species of the same genus having been subsequently received from the Gaboon, M. Chevrolat was enabled to characterize the genus from them. This he did in M. J. Thomson's 'Archives Entomologiques' (ii. 245), with the remark that "Our *Callidium sphæricolle* (Rev. et Mag. d. Zool. 1855, p. 283), from Old Calabar, enters into this genus."

M. Thomson, judging from the facies and some other characters common to it and the genus *Œme*, placed it, in his first work on the Longicorns (Essai &c. p. 251), among the Œmidæ. In his second work (Systema Cerambyc. p. 194) he placed it among the *Clytidæ*, to which it has a resemblance in the head and eyes. M. Lacordaire has retained it there, although, as he says, "non sans répugnance. Malgré ses yeux finement granulés, il serait peut-être mieux à sa place dans le groupe des Achrysonides."

Now the colour and texture would carry it to the Œmidæ. Like the majority of them, the Gaboon species is of a bright testaceo-ferruginous colour; and the Old-Calabar one is only a little darker, and, if fresh, without having been in spirit of wine, might perhaps be as bright.

At first sight, but only at first sight, the geographical distribution would appear to tell as much one way as another. I assume that the rule is that where the same type is found in two different countries, their presence in both is due to the lands having been, in some way or other and at some previous time or other, connected by dry land. I by no means say that their presence may not be due to accidental dispersion by flotsam and jetsam; but I maintain that, if so, that is the exception, and that the *prima facie* presumption is in favour of union. Good reasons may be given against it; but until these are given, we should not have recourse to that exceptional mode of explanation. Hitherto the inclination has been to hold that dispersal by flotsam and jetsam is the rule, and by former continuity the exception; but I think I see indications that scientific opinion is veering round in the opposite direction. Be that as it may, that is my position: the reader may reject it or not on its merits; but it supplies a basis on which I would judge of the affinity of the genus in question. In a paper on the geographical relations of the different Coleopterous faunæ, which is now in the hands of the Linnean Society for publication, I have given reasons for holding that at a very ancient date West Africa was disunited from the rest of Africa, that at the same date Brazil was isolated from the

rest of America, and that the two were then united together.

The numerous instances to which I have already had to draw attention, in the course of this work, of forms now predominating in Brazil and properly known as Brazilian types being also found in Old Calabar, show, according to my mode of interpretation, that a connexion formerly did exist between these two portions of the old and new continents; and I refer it to that particular period for several reasons: one is that there are some particular groups of beetles which have not been communicated to West Africa from Brazil, although now common there; and these are invariably, so far as my examination has yet gone, not truly species of the natural Brazilian type, but species of the European type. Few men who have studied the geology and geogeny of Brazil will dissent from the opinion that it was once isolated from the rest of America. This is a safe assumption, and is a step to prove the original absence of the European type from Brazil; and it seems to stand to reason that after Brazil ceased to be isolated, it would be invaded by the North-American type, which is only another phase of the European type. If it had been so invaded, and at the time of its connexion with Africa the fauna was composed of the same proportions of Coleoptera of European and of Brazilian type as now subsist in it, the same proportions ought to have migrated into and be now found in West Africa. Therefore, if none of the European type now present in Brazil are found in West Africa, but plenty of the true Brazilian, it seems to fix the date when the intercommunication took place. We must guard ourselves here from being confused by the introduction of the European type into West Africa, direct from North Africa or in other directions, in more recent times; but very little of this has come in, no doubt from the physical isolation, still subsisting, in consequence of the deserts or barriers surrounding it; and we can generally refer what has come to its proper source by inquiring whether it is now present in Brazil. Thus the Staphylinidæ are properly a European form which is now largely developed in Brazil; but I have never met with one from West Africa. By the kindness of my Old-Calabar missionary friends, I have had the opportunity of examining thousands upon thousands of all sorts of insects from that country, from the most minute Phytophage to the *Dynastes Centaurus*, and I have never seen a single *Staphylinus*: that is not chance. They are also very rare in other parts of Africa and in India; but I must refer to the paper I have above spoken of for an explanation of the mode in which this

trifling infusion has probably been derived there. *Clytus* is another European genus which has made good its entrance into Brazil; but not a genus nor a species occurs in West Africa, nor, indeed, in Africa at all (always understood Africa south of the Sahara) except a single small species at the Cape.

Then, again, another argument in the same direction is deducible from the strong presumption that in recent geological times an Atlantic continent stretched down between West Africa and Brazil from the Azores southwards. In the different patches of land (the islands of Madeira, Canaries, &c.) which are the surviving remnants of this continent we have many species of Coleoptera identical with those of Europe, and a still greater number most closely allied to them; and that fact in itself, I think, shows that the existence of this Atlantic continent must have been more recent than the connexion between Brazil and West Africa; for, although Africa has many species closely allied to those in Brazil, they are fewer than the allied species of Europe found in Madeira &c., and not above two or three instances of actual identity of species can be pointed out: and the case in which most similarity and identity of species is to be found ought surely to be regarded as the most recently united; for the greater the lapse of time, the greater the opportunity for changes of condition and consequent alteration in species. Independent of this altogether, however, if it is once admitted that the Atlantic continent must have been of recent date, it follows that it must have been the last; for the faunas show the last relation still surviving; and therefore the equatorial connexion between Brazil and Africa must have been older; for they could not both have existed at the same time, as is proved by the entire absence of the Brazilian element in the Atlantic faunas.

Applying these considerations to the case before us, they will correct the first impression that might naturally occur to to us, viz. that *Œdenoderus* was just as likely to belong to the *Clytidæ* as the *Œmidæ*, as both until now occurred in Brazil, but not in West Africa; for if we separate the Brazilian types into aboriginal Brazilian and naturalized European in Brazil (some of the former of which have been found in West Africa, but none of the latter), we get a test which at once shows that at any rate it is not to the Clytidæ that *Œdenoderus* ought to be referred: it then lies between the Œmidæ and the Achrysonidæ (a group also suggested by Lacordaire); but I think the facies and form is more that of the former than the latter. And if Lacordaire is right in placing the European genus *Icosium* in it (which, however, I doubt), that seems an additional reason for giving the preference to the Œmidæ.

Œdenoderus sphæricollis.

Callidium sphæricolle, Chevr. Rev. et Mag. d. Zool. 1855, p. 283.

Lividus, minute scabrosus; antennis gracilibus pedibusque pallidis; capite antice quadrato et oblique declivi, in longitudine obsolete canaliculato; mandibulis brevibus, crassiusculis, triangularibus, apice nigris, juxtapositis; oculis subrotundatis, postice rectis et supra depressis; thorace valde globoso, marginato in basi et fortiter constricto; scutello elongato triangulari; elytris thoracis latitudine, usque ad apicem sensim attenuatis et singulatim anguste rotundatis, in humero arcuatis et intus basi depressis.

Long. 4 lin., lat. $\frac{3}{4}$ lin.

Livid, finely scabrous; antennæ slender, and feet pale. Thorax globose, marginate, and strongly constricted. Scutellum elongate triangular. Elytra attenuate at the apex.

Only one specimen received, which I gave to M. Chevrolat.

TRACHELOPHANES*, genus novum.

Caput rotundatum, antice elongatum. Oculis subtriangularibus, convexiusculis, supra et intus subemarginatis. Antennis brevibus, circiter sesqui corporis longitudine, undecim articulis elongatis subæqualibus, tertio quintoque tamen longioribus. Thorax elongatus, duplo longior quam latior, cylindraceus, medio modice subampliatus, antice posticeque rectus et supra leviter depressus. Scutellum transversim rotundatum. Elytra thorace latiora et duplo tamen longiora, parallela, apice rotundata et in sutura subrectangula. Pedes femoribus, late clavatis, subcompressis; tarsi articulo primo conico, secundo quadrato, tertio longe bilobo, sat lato, unguiculis brevibus curvatis.

I agree with M. Chevrolat and Prof. Lacordaire in thinking that a new genus is necessary for the following species. It is at once distinguished from *Hesperophanes* by its cylindrical neck.

Trachelophanes puberulus.

Hesperophanes? puberulus, Chevr. Rev. et Mag. d. Zool. 1855, p. 284.

Validiusculus, brevis, rufus vel fusco-obscurus, crebre et mediocriter punctatus, pube cinerea indutus; palpis pedibusque ferrugineis.

Long. 6 lin., lat. $1\frac{3}{4}$ lin.

Rufous or obscure fuscous, short and stout, closely and mo-

* Τράχηλος, *neck*, in allusion to its elongated thorax (which is its most patent distinction from *Hesperophanes*), and φαίνω, *I appear* (apparent). Allied to *Hesperophanes*.

derately deeply punctate, and clothed with a cinereous pubescence. Palpi and legs ferruginous.

Only one specimen received, which I gave to M. Chevrolat.

Cerasphorus, Serv.

Cerasphorus murinus.

Ceropogon murinum, Chevr. Rev. et Mag. d. Zool. 1856, p. 568.

Punctulatus, griseo-murinus; palpis, antennis (villosis corpore longioribus) pedibusque (geniculis obscuris) pallidis; thorace rotundato, arcubus duobus oppositis elevatis, ad latera anguloso spinoso; elytris parallelis, angustissime truncatis et fere emarginatis (fœmina).

Long. 9 lin., lat. 6 lin.

Very densely pubescent and finely punctate, of a dirty pale grey colour. Head rounded, elongated posteriorly, deeply channelled. Palpi, antennæ (which are clothed with a long pubescence, and are longer than the body), and legs pale ferruginous. Mandibles pubescent, smooth and black at the extremity. Thorax rounded above, truncated, straight both in front and behind, and grooved along the margin, bearing on the disk a sort of horseshoe in relief, and on the side a little beyond the middle a sharp angle. Scutellum rounded. Elytra straight at the base, somewhat convex, parallel, narrowly truncated and emarginate at the extremity, scarcely broader than, and three times as long as the thorax. Legs tolerably long, ferruginous; thighs regularly thickened towards the middle, slightly flattened on the anterior side; knees obscure. Abdomen swollen, composed of five segments.

This species comes near the *Cerasphorus hirticornis* of Serville, but may be distinguished by the following characters:—The antennæ and the legs, in place of being of the general colour of the body, are ferruginous; the thorax, which in the preceding species is furnished on the disk with four angular tubercles, only bears a sort of raised semicircle placed longitudinally; and, lastly, the lateral spine is shorter and not so sharp.

Only a single specimen received, which I gave to M. Chevrolat.

Anisogaster, Deyr.

Anisogaster? semifemoratus.

Heterogaster? semifemoratus, Chevr. Rev. et Mag. d. Zool. 1856, p. 569.

Ochraceo-fuscus; antennis pedibusque rufis, cum dimidia parte

apicali femorum nigro-nitidis; mandibulis oculisque nigris; thorace brevi, antice subanguloso et postice recte truncato, basi trinodoso; scutello rotundato; elytris thorace multo latioribus, planiusculis, antice posticeque rotundatis, in sutura aculeatis, costulis duabus longitudinalibus obsoletis. Long. 8½–9 lin., lat. 2¾–3 lin.

Pubescent and of a reddish-yellow colour. Head rounded in front, cylindrical behind, shortly grooved between the eyes, but flat, plicate, and grooved in front. Eyes black, projecting, emarginate above. Palpi brownish. Mandibles black, moderate, bent, sharp, punctate. Antennæ ferruginous, with the first article thick, cylindrical, of the length of the fifth; second nodular; third and fourth equal, slightly swollen at the apex. Thorax as long as broad, projecting on the head, and of its breadth at their junction, straight behind, two-grooved transversely, sides obtusely projecting in the middle, attenuated towards the posterior angle, which is oblique and truncate behind; three tubercles behind near the base. Scutellum rounded. Elytra broader than the thorax, flattened, raised and rounded on the shoulder, each rounded at the apex, with a spine at the suture and two longitudinal obsolete ridges. Legs short, the first four tolerably near at their insertion, posterior longer, ferruginous, with the thighs ferruginous at the base, afterwards of a brilliant black, and a little swollen; the anterior are bent and depressed in front; claws simple. Abdomen with five segments, swollen, depressed on the margins of the segments, which are rather broad and decreasing in size from before backwards.

M. Chevrolat placed this species in the genus *Heterogaster* (now *Anisogaster*) with doubt; but as I have parted with the only specimen I received to him, and as I cannot trace it in the British Museum, although his collection has been secured by that institution, I am obliged to leave it as he has placed it, with a point of doubt. *Anisogaster* is a genus which as yet has been found only in Mauritius.

OSSIBIA, Pascoe.

Ann. & Mag. Nat. Hist. 1867, xix. p. 311.

Ossibia fuscata.

Obrium fuscatum, Dej. Cat. p. 358 (mas).
—— *ustulatum*, Dej. Cat. p. 358 (fœm.).
Obrium? fuscatum, Chevr. Rev. et Mag. d. Zool. 1856, p. 570.
Ossibia fuscata, Pascoe, *loc. cit. supra.*

Linearis, depressa, lurida, crebre punctata denseque cinereo pilosa; antennis (basi prætermissa) elytrisque lateribus late

infuscatis; oculis amplis, nigris, fortiter granulatis; thorace longiore quam latiore, lateribus medio subangulosis; abdomine pedibusque pallidis.

Long. 4–5 lin., lat. 1–1½ lin.

Linear, depressed, livid testaceous, strongly and closely punctate, clothed with an ash-coloured pubescence. Head rounded, square and hollowed out in front. Eyes large, rounded, coarsely granulated, black, tolerably distant from each other, emarginate above. Antennæ blackish, with the first two articles pale; first large, slightly bent; second half as long as the third; third and fourth equal; the remainder larger, cylindric, larger in the male than in the female. Thorax longer than broad, straight in front and behind, sides angular in the middle, impressed and unequal on the disk. Scutellum moderate, rounded. Elytra broader than the thorax, subrectangular at the humeral angle, each regularly rounded at the apex; they are dull livid, but distinctly yellowish along the suture. Abdomen and legs of a livid yellow; thighs regularly thickened in the middle, but slightly compressed when looked at from above.

The male differs from the female in having larger antennæ and a narrower thorax keeled in the middle above and scarcely angular on the sides. Considerable variation occurs in the coloration of different individuals of the same sex.

M. Chevrolat, in describing this species, followed Dejean, and placed it under the genus *Obrium*; but he did so with the qualification that it ought to constitute a new genus near *Methia*, Newm. Subsequently Mr. Pascoe (*loc. cit.*) described it under the name here adopted, but without expressing any opinion as to the affinities of the genus. Prof. Lacordaire has overlooked it; but I think it should come near *Œme* and its allies.

Not rare. In many collections—British Museum, Pascoe's, Fry's, my own, &c.

APHOPLISTUS*, nov. gen.

Angustus, parallelus, alatus, irregulariter sparsim punctatus et tenuiter pilosus, textura opaca. Caput parvum, mandibulis parvis; labrum transversum, recte truncatum; palpis tenuibus, brevibus, articulo ultimo ceteris paululum latiore, truncato; labio brevi, lato, vix emarginato; oculis sat fortiter granulatis, lateralibus, distantibus, subreniformibus, subtus multo majoribus et latioribus; antennis (fœm.) te-

* Ἀφοπλιστός, *disarmed,* in allusion to the absence of spines on the thorax.

nuibus, simplicibus, dimidia corporis longitudine, undecim articulis, primo majore, tertio longiore, quarto tertio dimidio breviore, quinto tertio fere æquali, sequentibus gradatim minoribus. Thorax capite duplo longior, sine spinis vel tuberculis æqualiter subovatus, ad medium latior, antice et postice recte truncatus, sat convexus, dorso hic et illic leviter impressus. Scutellum semicirculare. Elytra dorso subplana, thorace sesqui latiora et fere triplo longiora, ad basin recte truncata, ad humerum rotundatim rectangula, in lateribus parallela et ad apicem regulariter rotundata. Pedes breves, validiusculi, inermes; femoribus modice clavatis, ad imum infra breviter canaliculatis; tibiis simplicibus; tarsis brevibus, subtus dense setosis. Subtus modice convexus, æqualis; prosternum postice arcuatum; coxis anticis et intermediis distincte apertis. Abdomen quinque segmentis, primo latiore, sequentibus gradatim minoribus.

This genus should come, I think, somewhere between *Hesperophanes* and *Sphærion*. It has at first sight a good deal of resemblance to *Asemum*; but a more careful examination shows that this is only superficial. The texture is different, the thorax and the eyes different in shape, the antennæ more slender, and the underside of the tarsi clothed with a thick brush of hair, while in the *Asemidæ* it is only sparingly furnished with finer hairs. The ligula would supply a test by which it could at once be settled whether it belongs to the section in which the Asemidæ are placed, or to the section to which I have referred it; but I have only one specimen in rather a fragile state, and I hesitate to risk it in dissecting out the ligula, the more so that I think the above characters are sufficient to show that it does not belong to the Asemidæ, but that it either belongs to the Hesperophanidæ or is in their vicinity.

The species for which I have found it necessary to propose this genus was described by M. Chevrolat as an *Œmona*; but it seems to me not to belong to the group in which *Œmona* is placed, and is most certainly not an *Œmona*, which has a cylindrical thorax with transverse folds or wrinkles, neither of which this has.

Aphoplistus pilosellus.

Œmona pilosella, Chevr. Rev. et Mag. d. Zool. 1858, p. 53.

Saturate purpureo-brunneus, fere niger, sat crebre sparsim irregulariter punctatus, pilis brevibus inflexis cinereis sat dense vestitus; labio et palpis ferrugineis; antennis nigris.

Long. 7 lin., lat. 2 lin.

Deep purplish brown, irregularly and sparsely punctate,

covered with sparing ashy hairs springing from the punctures, generally bent. Palpi and labium ferruginous. Mandibles and antennæ black. Scutellum smooth, black, and impunctate. Legs fuscous. Body below lightly pubescent and finely punctate.

I have only seen a single female specimen. In my collection.

Hesperophanes, Muls.

Hesperophanes fasciatus.

Callidium fasciatum, Bilberg, Appx. ad Schön. Syn. pp. 191, 269.
Hesperophanes caliginosus, Dej. Cat. 3rd ed. p. 354.

Valde pubescens, fusco-castaneus; capite, thorace fasciisque tribus elytrorum villoso canescentibus; antennis longis.
Long. 6–12 lin., lat. 1½–3 lin.

This has come in tolerable abundance.

Smodicum, Lec.

Smodicum ebeninum, Pl. II. fig. 3. Chevr. Rev. et Mag. d. Zool. 1855, p. 183.

Dense punctulatum, nigro-piceum, nitidum; antennis (11 articulis) pedibusque obscure rufis; capite longitudine sulcato; thorace longiore quam latiore, subovali, antice posticeque recto, vix marginato, in dorso circulatim depresso; elytris rotundatis, bicostatis; corpore infra nitidiore; abdomine quinque segmentis.
Long. 7 lin., lat. 2 lin.

Piceous black, densely punctulated, shining; antennæ and legs dull rufous. Head longitudinally sulcate. Thorax longer than broad, somewhat oval, scarcely margined, with a circular depression on the disk. Elytra rounded, with two costæ. Body below more shining. Abdomen with five segments.

In Chevrolat's and my collection.

This is the first instance that has occurred of a species of the American genus *Smodicum* having been met with out of the New Continent.

Distenia, Serv.

Distenia apicalis, Rev. et Mag. d. Zool. 1855, p. 290.

Nigro-picea, nitida; ore, palpis, antennis, elytris basi et apice, pedibus (femoribus medio geniculisque nigris) anoque rufopallidis; thorace antice posticeque recto, transversim bistricto, lateribus angulato; elytris singulatim in humero late, in apice anguste rotundatis, punctato-striatis (sex striis,

secunda ante medium tertiaque prope maculam apicalem, abbreviatis).

Long. 7 lin., lat. 2 lin.

Shining piceous black; the mouth, palpi, antennæ, the base and apex of the elytra, the legs (except the middle of the thighs and the knees, which are black), and the termination of the abdomen pale rufous. Thorax constricted transversely before and behind, the sides angled. Elytra punctate-striate—six striæ, the second abbreviated before the middle, the third near the apical spot.

One specimen. This also is a Brazilian genus.

[To be continued.]

XV.—*On two New Species of Subspherous Sponges, with Observations.* By H. J. Carter, F.R.S. &c.

[Plate XIII.]

At the request of my kind friend Dr. J. E. Gray, I have examined, described, and illustrated the two following Sponges belonging to the British Museum. Both appear to me to be new, and one the type of a new genus. The former is a *Tethya*, and, from its dark purple colour externally, will be designated "*atro-purpurea*;" and the latter, from its asperity externally, will be generically termed "*Trachya*," and specifically "*pernucleata*," from the number of nucleated groups of spicules internally.

Let us direct our attention to the former first.

Tethya atro-purpurea, mihi. Pl. XIII. figs. 1–10.

Sessile, subcircular, convex, compressed, muricated externally, presenting a radiated structure inferiorly, where it appears to have been excised horizontally from the object on which it grew. Surface covered with a dark purple, smooth layer of sarcode, interrupted by the spine-like projections which give it the muricated appearance, and which are composed of bundles of spicules, now truncated by fracture (Pl. XIII. fig. 5, *a*), but which probably, in the natural state, protruded from them in a brush-like form (fig. 6); raised into aliform ridges (fig. 5, *b*) extending from the base of one spine to the other, and thus forming polygonal interspaces in which are situated the pores, with here and there an osculum. Internally composed of radiated structure consisting of long, straight spicules extending, in bundles, from the centre of the base to the periphery (fig. 4, *a*), imbedded in a light-brown

coloured sarcode, densely charged with a peculiar sigmoid spicule, and permeated in all directions by the canal-system (*d*), which is most dilated about midway between the centre and the circumference, but so amorphous as to represent an areolar vacuolation rather than a branched structure; limited at the surface by a condensed cortical layer of the sarcode, neatly defined on its inner margin, by its dark purple colour, from the light-brown-coloured sarcode of the interior (*b*). Spicules of the radiated structure of three kinds (fig. 7), viz.:—1, stout, long, straight, smooth, fusiform, acerate (*a*); 2, trifid extended or furcate (*c*); and, 3, trifid recurved or anchorate; the last two with very long, delicate, slightly fusiform, smooth, straight, pointed shafts. Spicules of the body or light-brown sarcode of the interior of two kinds (figs. 8 & 9), viz.:—1, stout, short, slightly curved, smooth, fusiform, acerate, with one half generally a little larger than the other (fig. 8); and, 2, minute, doubly sigmoid, or circular (that is, sigmoid in opposite directions, or spiral), contort (fig. 10, *a*, *b*), sparsely spinous on the shaft, and terminated at the extremities by three diverging spines about the same size—something between a hamate and an anchorate form; spines of the shaft vertical, pyramidal, chiefly situated upon the prominent parts of the shaft. This spicule is so numerous as to form the greater part of the bulk of the fleshy substance. Size of sponge 11-12ths of an inch in horizontal, and 3-12ths of an inch in vertical diameter.

Loc. et hab. Unknown.

Obs. Described in a dried state, aided by soaking in water &c. Probably convex on its surface throughout, when fresh, but now possessing the depression in the centre, as represented in the figure, which seems to have arisen from collapse of the vacuolar or canal-system internally during desiccation.

The dark-purple colour and muricated surface are striking features of this sponge. All the spine-like processes are truncated; but probably, in their original and uninjured state, each had a pencil of spicules extending beyond the sarcode (fig. 6), composed of a variable number of the kinds above described as peculiar to the radiated structure, the furcate and anchorate heads of the long-shafted spicules being outermost, while the simple points belong to the stout acerate spicule, which accompanies and contrasts forcibly with them in its robustness and inferiority of number.

These characters, with the smooth polygonal areas in which the pores are situated, and here and there an osculum, together with the radiated structure internally, limited by the cortical condensation of the sarcode at the circumference, which thus

keeps all the elements of the surface in proper position, coincide strictly with what has been stated and figured of *Tethya cranium* (Johnston, Hist. Brit. Spong. pl. 1. figs. 1 &c.) and of *T. arabica* (Annals, 1869, vol. iv. pl. 1. figs. 1 &c.).

The sigmoid spicules, too, evidently exist in both these species of *Tethya*, in a minuter form (Bowerbank, Brit. Spong. vol. ii. p. 85, and Annals, *l. c.*), but being so much larger in *T. atro-purpurea*, where they can be easily seen in detail with a quarter-of-an-inch compound power, are thus much more satisfactorily illustrated.

I could not discover any gemmules.

Besides being sessile, this species might occasionally exist in a subspherous form, free and unattached, like *T. arabica*, as I know from actual experience such to be the habit of these *Tethyœ*. But the specimen under description appears to have been cut off from the rock or object on which it grew, and that, too, a little above its real base, as there is no nucleus present in the latter, nor any point indicative of the centre from which the mass emanated; probably this was left upon the rock.

TRACHYA, nov. gen., mihi.

Gen. char. Asperous, massive, cake-shaped, free or fixed, dense, rigid. Osculiferous. Internally multinucleate. Spicules of two kinds only, viz. large and small: large spicule smooth, fusiform-accrate; small spicule, which is chiefly confined to the upper surface, smooth, fusiform-acuate.

Trachya pernucleata, n. sp. mihi. Pl. XIII. figs. 11–16.

Free, subcircular, compressed, convex above, concave below. Superiorly asperous, lobate, irregular, of a dark-grey colour, presenting here and there an osculum amidst the projecting points of the spicules vertically arranged which, together with condensed sarcode and minute depressions for the pores, form a continuous rigid surface (Pl. XIII. figs. 11–13). Inferiorly equally asperous, of a lighter colour, presenting here and there oscula more or less situated in groups in depressions (*c*), but with the spicules lying on or inclined towards the surface, in flattened whorls or radiated groups (fig. 15), not projecting vertically, as on the upper surface (fig. 13). Internally composed of an extremely dense structure formed chiefly of nuclear masses of spicules radiating from their centres respectively, and intermingling with each other or extending to the exterior, where they terminate above in the vertical arrangement just mentioned, strengthened by the addition of a much smaller spicule, of a different form, thickly set in between the

larger ones (fig. 13, *b b*); while below the smaller spicule is more or less absent, and the radiating spicules become inclined towards the surface in the whorls, as above noticed (fig. 15). Canal-system distinct, but correspondingly condensed and small in its cavities, in accordance with the compact structure of the sponge generally; presenting no evident arborescent form, but general diffusion between the nuclei (fig. 14 *b*). Spicules of two kinds only (fig. 16), viz.:—1, stout, straight, smooth, fusiform, acerate or pointed at each end (*a*); and, 2, small, straight, smooth, slightly fusiform or acuate, pointed at one end only and the other rounded or obtuse (*b*). This spicule is, as above stated, chiefly confined to the *upper* surface, where, arranged vertically, with its sharp end outwards, among the points of the larger spicules, it contributes greatly to strengthen the surface and form a kind of crust. Size of sponge $2\frac{1}{4}$ inches by $1\frac{7}{12}$ inch in horizontal and $\frac{4}{12}$ inch in vertical diameter.

Loc. et hab. Vera Cruz, Mexico.

Obs. Described in the dried state.

At first this sponge looks very much like a *Tethya*; but the absence of the furcate spicules, together with its other differences in structure, soon shows that it cannot be classed with *Tethya* generically. Then the absence of the crust of globular crystalloids peculiar to the Geodidæ, with its numerous other differences from these, points out that it cannot be generically classed with either *Geodia* or *Pachymatisma.* And yet its dense rough character and cake-like free form evidently ally it to the subspherous sponges, so that it becomes necessary to form a new genus for it in this family. Hence it has been called "*Trachya*," from its asperous nature, which, although not a legitimate transformation of the word grammatically, nevertheless linguistically euphonizes sufficiently well with *Tethya* and *Geodia* to induce me to adopt it.

It will have been observed that, although *Trachya* has not the exact elements of *Tethya* or *Geodia* for its crust, yet the addition of the small spicule arranged vertically in great numbers among the projecting points of the large ones on the upper surface (fig. 13) supplies this apparent deficiency; while the number of nuclear centres in the internal structure not only causes the species to distinctly differ widely from *Tethya* and *Geodia*, but to assume that hardness and rigidity characteristic of the subspherous sponges which nothing could impart better than this knotted structure.

General Observations.

I have also examined a third sponge belonging to the Museum, which has grown upon the root of a palm-tree; and this

is evidently a variety of *Geodia arabica* (Annals, 1869, vol. ii. *l. c.*), differing only in the canal-system being less arborescent and the ends of both the shafts and branches of the large triradiate spicules of the circumference being frequently obtuse, rounded, or inflated—thus more resembling *Pachymatisma*. But the body-spicule of *Pachymatisma*, being round or inflated at both ends, alone distinctly separates it from *Geodia*; while *Tethya lyncurium*, from the absence of the furcate spicules, on the one hand, and the position of the large stellate spicules (which are for the most part situated on the *inner* side of its cartilage-like crust), on the other, is neither a *Tethya* nor a *Geodia*, nor a *Pachymatisma* (see my figures, 'Annals,' *l. c.*). Hence *Tethya lyncurium* should also have a separate genus.

As regards the describing of sponges generally, it is very desirable that no spicule should be figured in connexion with them which is not strictly characteristic of the species. The introduction of varieties and monstrosities, with which every specimen more or less abounds, I am persuaded is as much a mistake as it would be to omit them from a dissertation devoted to the formation and development of the spicule generally. Here the varieties and monstrosities might appear to advantage; but figured with the characteristic spicules of the species in which they may have been observed, they are only calculated to confuse and mislead.

I have therefore, although I have found different hamate and stellate spicules about the specimen of *Tethya atro-purpurea* (above described), regarded them as adventitious products, which it is more desirable to retain mounted in balsam for the purpose mentioned than to figure any of them, even as such, in connexion with the spicules of this sponge.

Again, it should be remembered that sponges grow together like grafts upon a tree-stock; and thus, besides varieties, monstrosities, and adventitious spicules accidentally incorporated with the mass during its growth, there may be others actually developed in the midst of it. Thus, at the circumference of *Tethya arabica*, I found a group of triradiate spicules similarly developed and situated to those at the circumference of *Geodia arabica* (Annals, *l. c.* p. 4), whose explanation at the time I did not understand; but now it appears to me that, as different species of sponges are frequently found growing together in much the same condition as grafts on a tree-stock, this might have arisen from a gemmule of a neighbouring *Geodia*, which had accidentally impinged upon the *Tethya*, and, growing there, had thus become incorporated, and had produced the group of triradiate spicules to which I have alluded.

H. J. C. del. Tuffen West sc.

W. West imp.

Hence, in the description of beings so naturally prone to adhere and grow together, to produce varieties and monstrosities in their spicules, and to incorporate with themselves adventitious and external objects, as the sponges, it is very desirable to ascertain what really does and what does not belong to them, and to figure that only which is characteristic of them, of normal form and dimensions.

EXPLANATION OF PLATE XIII.

Fig. 1. *Tethya atro-purpurea*, n. sp., dried state, natural size; upper surface: *a*, spine-like projections.

N.B. The depression in the centre externally has probably arisen from collapse of the vacuolar or canal-system internally during desiccation.

Fig. 2. The same, horizontal section of the base (probably produced by the cutting of the sponge from the body on which it grew), showing:—*a*, spine-like projections; *b*, dark cortical layer of the circumference; *c*, portions of the radiating bundles of spicular structure imbedded in the fleshy substance of the interior; *d*, fleshy substance; *e e*, cavities of the canal-system.

Fig. 3. The same, imaginary section, to show the vertical diameter of the specimen.

Fig. 4. The same, segment, magnified a little more than two diameters, showing:—*a*, spine-like projections; *b*, dark cortical layer; *c*, radiating bundles of spicules extending from the centre to the spine-like projections on the circumference; *d*, fleshy substance of the body; *e*, cavities of the canal-system.

Fig. 5. The same, portion of the surface, magnified four times, showing:—*a*, the relative position of the spine-like projections, with their truncated ends, exposing the fractured extremities of the spicules of which they are composed, as indicated by the black points; *b*, wing-like ridges of the superficial layer of sarcode extending outwards from the bases of the spine-like bodies, and thus forming polygonal areas in which are situated the pores, as indicated by the dark points.

Fig. 6. The same, a spine-like projection, magnified, to show its probable state before the protruding ends of the spicules were broken off.

Fig. 7. The same, spicules of the radiating bundles, relatively magnified: *a*, straight, stout, smooth, fusiform, acerate spicule; *b*, real length, about 1-7th of an inch, greatest thickness about 4-1800ths of an inch; *c*, trifid, extended, or trifurcate spicule, with long, delicate, smooth, pointed shaft; *d*, real length, about 1-5th of an inch, greatest thickness about 1-1800th of an inch; *e*, trifid, recurved, or anchorate spicule, with long, delicate, smooth, pointed shaft; *f*, real length, about 1-5th of an inch, greatest thickness about 1-1800th of an inch; *g*, *h*, more magnified figures of the trifurcate and anchorate heads respectively.

Fig. 8. The same, body-spicule of the fleshy substance: short, stout, smooth, fusiform, slightly curved, acerate, generally larger on one side than the other; 1-30th to 1-20th of an inch long, and 3- to 4-1800ths of an inch in its thickest diameter.

Fig. 9. The same, portion of the fleshy substance, much magnified, to show how densely it is charged with the contort sigmoid spicules.

Fig. 10. The same, two of the sigmoid spicules, greatly magnified, as seen with a quarter-of-an-inch compound power, showing the spines on their shafts and extremities respectively: *a*, sigmoid form; *b*, circular form. Size about 1-400th of an inch long, and about 1-12000th of an inch thick.

N.B. These spicules have a double sigmoid or spiral curve, consisting of about two turns of the spire altogether, but so different individually that it is only here and there that a true sigmoid form is seen, the rest presenting a curvilinear one like a fragment of a circle (*b*); yet they are all contort, and could not be made to lie *flat* on a plane surface.

Fig. 11. *Trachya pernucleata*, n. gen. et sp., dried state, half the specimen, natural size, upper surface: *a*, oscule.

Fig. 12. The same, portion of upper surface, greatly magnified, to show:—*a*, the depressions in which the pores are situated; *b*, the ridges between them formed by the projecting points of the large and small spicules, which have been broken off, as indicated by the black circular dots.

Fig. 13. The same, diagram to show the relation of the large to the small spicules, and their vertical arrangement so as to form a hard crust on the upper surface: *a a*, large spicules; *b b*, small spicules.

Fig. 14. The same, horizontal view of vertical section of corresponding half of fig. 11, natural size, showing internal structure composed of:—*a a*, nuclear or radiating groups of spicules; *b*, cavities of canal-system; *c*, group of oscules in a depression in the lower surface.

This section also shows the dark-grey colour of the upper portion passing into the lighter one of the under surface.

Fig. 15. The same, whorl or radiating group of large spicules, much magnified, to show their superficial arrangement on the under surface of this sponge, and the comparative absence of the small spicule.

Fig. 16. The same, the large and small spicules, relatively magnified: *a*, large spicule, stout, straight, smooth, fusiform, acerate; *b*, real length, about 1-18th of an inch, greatest thickness about 3-1800ths of an inch; *c*, largest size of small spicule, straight, smooth, fusiform, acuate (that is, needle-shaped or pointed at one end and obtuse at the other). Size about 1-60th of an inch long by about 1-1800th of an inch in its greatest transverse diameter.

XVI.—*Notice of a new Vitreous Sponge*, Pheronema (Holtenia) Grayi. By W. Saville Kent, F.Z.S., F.R.M.S., of the Geological Department, British Museum.

The recent dredging-expedition of the yacht 'Norna,' owner and commander Mr. Marshall Hall, F.G.S., in which I had the pleasure of being associated with Mr. Edw. Fielding, resulted in our obtaining, off Setubal, in addition to many other most interesting organisms, a vitreous sponge closely allied to *Holtenia Carpenteri*, Wyv. Thomson. At the time of taking it I strongly suspected it to be identical with

that form; but subsequent examination and reference to the paper describing the species, and the institution of comparisons between our specimens and those placed in the British Museum, have led me to believe that it is necessary to establish a specific distinction between them.

Giving here a brief notice of the principal differences which seem to warrant their specific separation, I reserve fuller particulars for a future more general report.

These distinctions are, that, in the first place, relative to the external contour of the sponge-body, *Pheronema* (*Holtenia*) *Grayi* (I dedicate this species to my kind friend Dr. J. E. Gray, to whom I am indebted for many suggestions regarding its specific individuality) is always more or less globose, or even in the form of a depressed sphere, the axis of the transverse diameter being the longest, and not subcylindrical as is generally the case in *Holtenia Carpenteri*. The large oscular orifice, again, is frequently funnel-shaped, expanding outwards, instead of being cylindrical as in the last-named species. The spicules of the fringe bounding the margin of this oscular cavity are also generally shorter and more closely set than in *H. Carpenteri*; and the external wall of the upper portion of the sponge, instead of having rigid spicules projecting throughout its surface, as described of *H. Carpenteri*, has generally a smooth area to the extent of one-fifth or one-fourth of its surface, from which point the rigid spicula now commence and occur in moderate abundance for the next inch or so. Such are the principal points of external difference which would arrest the attention of the most ordinary observer.

Fully recognizing, however, the insufficiency of the characters afforded by external contour alone in the discrimination of species susceptible of so wide an amount of variation as the representatives of the Porifera, I should have felt much diffidence in proposing a new specific name for the form here introduced, had there not also been a corresponding difference in the characters of the spicules of which the sponge-body is composed. In this respect I have found, upon examination, that, besides the numerous forms figured and referred to by Prof. Wyville Thomson in his description of *H. Carpenteri*, in the 'Philosophical Transactions' for 1869, there are, associated with other long delicate forms (inclusive of those with adpressed spines) which enter into the composition of the fringe surrounding the osculum, many having a simple pin-head termination (spinulate, Bowerbank), and also others long, attenuate, and entirely and erectly spined (spines short and erect), characters sufficiently important in themselves for the recognition of a species. The spicules of the sarcode of

the second type (Wyv. Thomson), simple, stylate, slightly fusiform spicules having the shaft covered with delicate adpressed spines, appear also to be much more abundant in this species than in *Holtenia Carpenteri*.

In conclusion, a word of explanation is necessary for the generic title I have adopted here for this species, in place of that of *Holtenia*.

In accordance with the recognized laws of priority, that generic or specific name of an animal or plant must be retained under which the organism was first described (pre-Linnæan ones alone excepted); and the question is, has any sponge sharing the same generic characters been described and named previously to Prof. Wyv. Thomson's creation of the genus *Holtenia?* The description of a form from Santa Cruz by Prof. Leidy, (evidently overlooked by the founder of the genus *Holtenia*), seems to warrant my supposition that it has. The first reference made to this specimen was by Dr. Leidy, at the meeting of the Academy of Natural Sciences of Philadelphia, in March 1860, when, in calling the attention of the members to a specimen of *Hyalonema mirabile* just received from Japan, he expresses his conviction that the twisted coil of siliceous spicula belongs to a sponge, and adds, "This latter view is apparently confirmed by a specimen of a sponge in the cabinet of the Academy, from Santa Cruz, presented by the late Dr. Griffith. This sponge is an oblong oval mass, about four inches long, surmounted at one extremity with a corona of twisted cords of siliceous spicula [equivalent to the fascicles forming the beard in *H. Carpenteri*] about two inches in length. These spicula are very similar in structure to those of the *Hyalonema*, merely differing in size."

Subsequently, and previously to Prof. W. Thomson's creation and description of the genus *Holtenia*, Dr. Leidy recognized the necessity of forming a new genus for the reception of the very remarkable sponge just referred to, and bestowed upon it the title of *Pheronema*, adding the following essential characteristics:—

"The body of the sponge is oblong-ovoidal, with the narrower end upwards. The upper extremity is conical, with a truncate apex, presenting a large circular orifice, and which forms the exit of the canal which descends into the axis of the sponge for almost half its depth, and which then appears to divide into several branches. Its surface exhibits an intricate interlacement of stellate siliceous spicula inclosing a tissue of finer spicula of the same character, the whole associated by the dried remains of the softer sponge-tissues.

"From the lower end of the sponge there projects a number

of distinct or separate tufts of siliceous spicula, two or three inches in length [in other specimens these tufts would probably be found much longer, this portion of the sponge being susceptible to a very great degree of variation in the amount of development, as is instanced in the specimens of *Pheronema Grayi* before me]. In the single specimen preserved there are fifteen of these tufts intact, and about ten orifices from whence as many additional tufts appear to have been extracted."

Comparing this description of *Pheronema* with that of *Holtenia*, W. Th., it is impossible not to be struck with the close affinity of these two forms, or, in fact, not to recognize that they cannot be made otherwise than generically identical. Hence I have considered it necessary to describe under the name of *Pheronema* the new species I here introduce, and add the following as a synopsis of the species of the same genus which have so far been established—a number which, in consequence of the increase of zeal in the prosecution of deep-sea dredging-expeditions which is now being displayed, we have every reason to hope is likely very shortly to be still further augmented.

Order VITREA, Wyv. Thom.

Genus PHERONEMA, Dr. Leidy.

Sp. 1. ——, Leidy*.
Sp. 2. *Carpenteri*, (*Holtenia C.*) W. Th.
Sp. 3. *Grayi*, W. S. Kent.

The principal distinctive features of Dr. Leidy's species appear to be that the oscular region is produced in a truncate form, as in many of the old Greensand Siphonias, and that the fascicles of spicules forming the beard or rootlets of the sponge are shorter than in either of the other species—a character, however, hardly to be regarded as essential. Dr. Leidy does not particularize the characters of the smaller spicules belonging to the different regions of the sponge—though doubtless, on a closer examination, they would exhibit specific peculiarities.

The specimens of *Pheronema Grayi* obtained were taken in a depth of water varying from four to six hundred fathoms. The average measurements of these specimens are as follow:—

* I have not yet been able to find Dr. Leidy's original description, including the specific name, though I have searched through numerous American scientific publications in the libraries of the British Museum, the Royal, the Linnean, and the Zoological Societies. The one given above is taken from the 'Monthly Microscopical Journal' for June 1869.

Of the body-mass of the sponge, length and breadth from four to four and a half inches; the beard or anchoring rootlets from ten or twelve inches to upwards of two feet in length. Further details of the structure and affinities of this interesting production must be deferred for a future communication; but, before laying down my pen, I must not omit to acknowledge here how much I feel indebted to my friend Prof. Du Bocage, the eminent conservator of the Lisbon Museum, for the very kind and valuable assistance he rendered us in his anxiety that our expedition should not prove a fruitless one, by placing at our disposal so much of his valuable time, and by putting us in communication with the deep-sea fishermen in the neighbourhood of Setubal, through whose instrumentality *Hyalonema*, *Pheronema*, and many other of Ocean's loveliest productions were first demonstrated to be denizens of the Portuguese coasts.

BIBLIOGRAPHICAL NOTICE.

The Ornithosauria: *an Elementary Study of the Bones of Pterodactyles, made from Fossil Remains found in the Cambridge Upper Greensand, and arranged in the Woodwardian Museum of the University of Cambridge.* By H. G. Seeley, of St. John's College, Cambridge. With 12 Plates. 8vo, pp. 135. Cambridge and London, 1870.

"And when the appointed end comes they lie not dishonoured in forgetfulness" (Xenophon) is the motto chosen for this work. It is more than probable that the motto is applicable to the contents of the book; it is decidedly true of great quantities of fossils, collected as curiosities, or even as objects of scientific research. Often they are laid aside, and, for want of appreciation, or of a full recognition of the group of living things to which they are naturally allied, they wait for explanation until they fall into the hands of those who know their scientific worth, or of those to whom the progress of biology opens up the previously unknown, giving them new clues to the exploration of the obscure and labyrinthic paths of nature in the past. As with antiquities that come to the hands of the uncultured, or that may have been collected in past times, when spurious history and faint interest in foregone peoples were inimical to research, so with fossils; they mean nothing to the peasant, and are mistaken by the partially educated and prejudiced many; and they may as well be left in trust of the earth for better times, or be stored in locked cabinets till knowledge brings the key. Of late years the advance of Natural History has been rapid. The structures of Reptiles and Birds have been greatly elucidated; and the remains of extinct creatures having reptilian and avian affinities have been brought out from the phosphate-diggings near Cambridge,

and other sources, in great quantities, after their long burial, to the hands of those who know more of zoology than our predecessors knew. Their knowledge, of course, is as yet imperfect, and ever will be; but its light aids much in the discrimination of differences and similarities among these long-past creatures, and between them and their living representatives.

In the book under notice, Mr. Seeley first alludes to the collection of specimens he has to describe, the condition of the bones, and the place of their exhumation in the Greensand. Prof. Owen's memoirs on some of these bones, his views on the Pterosaurs, and the author's own works and views are next mentioned. A summary (chiefly after Von Meyer) of the opinions of palæontologists on the organization of Pterodactyles follows (a bibliographic list is appended); and Mr. Seeley's conclusions as to their organization and classification are given at pp. 24–27 and pp. 94–112. The body of the work comprises description of the specimens, with explanation of the probable affinities shown by the several bones. At pp. 112–128, twenty-five species of the new genus *Ornithocheirus* are described: several of these are new; and the rest have been removed from other genera. They are founded on the premaxillary and other bones of the snout, which vary in form, but are associated with teeth prolonged anteriorly to the muzzle, and with a longitudinal ridge on the palate.

This Catalogue is a welcome instalment of the grand series that the venerable Woodwardian Professor proposes to publish, as intimated in our notice of the Index Catalogue in the 'Annals' for March of this year. It clearly indicates the leading features and special characters of the Pterodactylian remains preserved in the Woodwardian Museum; and, after judiciously bringing together the published views of those who have treated of such Pterosaurian creatures, Mr. Seeley has discussed the chief points of relationship among the congeneric groups, according to the zoological system that appears to him the best for comprehending and explaining all the characteristics of the extinct creatures which these relics represent.

Mr. Seeley finds evidence that in these extinct animals "the general plan of the most vital and important of the soft structures was similar to that of living birds," and "that with such a common plan is associated a diversity of details sufficient to demonstrate that these animals are not birds, but constitute a new group of Vertebrata of equal value with the birds—the subclass *Ornithosauria*" (p. 27). The network of affinities connecting these and the other Vertebrates has, however, been studied by others with different results. Thus Huxley regards the natural ties so strong among Birds and Reptiles, including the Pterodactyles, as to necessitate their being regarded as one great group (*Sauropsida*), comparable with that of the *Mammalia*, the dissimilarities of structure among the Sauropsids being regarded as of less importance than the modifications that characterize the Mammals; and Owen sees closer ties between the Mammals and Reptiles than Huxley appears to have noted.

The elevation of the Cambridge Pterodactyles to a position equal to that of Birds rests upon inferences not well proved. Thus the structure of their heart is not known, but is inferred from the pneumatic condition of the bones (pp. 101 &c.). Pneumaticity, however, does not characterize some birds of the strongest flight, and the Bat is without it; hence Mr. Seeley's argument that the Pterodactyles must have been hot-blooded cannot be supported by the fact that some birds are more or less pneumatic. Nevertheless we may agree with Huxley that there is a *probability* of both Pterodactyles and Dinosaurs having had hot blood; and it is well to remember that Prof. Owen considers the hollowness of the bones to be merely an adaptive character, and of no great importance in a physiological point of view.

The osseous structure will not appear to every one so distinctly avian as it does to Mr. Seeley. With reference to the sternum, the Merganser is quoted as "a close ally" of the Pterodactyle; but, judging from pl. 1. fig. 1, it may be said that the sternum has more similarity to that of the Horse, and still more to that of the Bat, which, indeed, may be said to have a more avian tendency than the figured specimen. These modificational resemblances are of little value.

Again, Mr. Seeley shuts off the Pterodactyles from Reptiles on account of the presence of the synovial notch in the sternum; but the statement "that only in birds are distinct synovial cavities provided for the coracoids" (p. 28), though connected with Owen's name, will require modification; for when the junction of coracoid and sternum exists in Reptiles, it always has a synovial joint.

There is room, then, for further research in the affinities of Pterodactyles. Mr. Seeley has done good work in arranging and characterizing the Cambridge specimens in this very acceptable *Catalogue raisonné*, which bears good evidence not only of the author's known industry and biological knowledge, but of his talent for analytical and synthetic research among these lower Vertebrates.

Mr. Seeley thus correlates his *Ornithosauria*. I. *Pterodactylæ*, comprising:—*Pterodactylus*, Cuvier; *Ornithocephalus*, Sœmmering; *Pachyrhamphus*, Fitzinger; and *Cycnorhamphus*, Seeley. II. 1. *Rhamphorhynchæ* (*Ramphorhynchus*, Von Meyer); 2. *Dimorphodontæ* (*Dimorphodon*, Owen); 3. *Ornithocheiræ* (*Ornithocheirus*, Seeley).

The numerous figures in the lithographic plates are the work of the author's own pencil, and bear witness to his conscientious labour and enthusiasm; but they are not artistically good, and some are stated to have been damaged in the printing. They will be of more use in identifying the specimens in the museum than in conveying an accurate representation of indispensable detail to the student at a distance. Nevertheless they constitute a highly valuable and necessary adjunct to this portion of Prof. Sedgwick's projected great Catalogue of the Woodwardian Museum.

MISCELLANEOUS.

Notes on the Species of Wart-Hog (or Phacochœrus*).* By Dr. J. E. Gray, F.R.S.

Mr. Sclater, in the 'Proceedings of the Zoological Society' for 1869, p. 276, mentions, as added to the Menagerie:—"An Ælian's wart-hog (*Phacochœrus Æliani*), which had been captured near Zoulla, on the coast-district of the Red Sea, and brought to England in one of the transports engaged on the Abyssinian Expedition, April 15th (see pl. 20). This animal had been placed in the swine-house, next to the fine pair of Æthiopian wart-hogs from Natal (*P. æthiopicus*), which had been presented to the Society by H.R.H. the Duke of Edinburgh on the 6th of May 1866. The external differences between the two species were very obvious on comparison, the sides being much more naked in *P. Æliani*, while the hairs on the back and nape of the head were much thicker and longer. In *P. Æliani* the ears were longer, more pointed, and more naked; in *P. æthiopicus* these organs were densely clothed with hair. In *P. Æliani*, also, the whiskers are very long and well developed.

"One other specimen of Ælian's wart-hog had been previously living in the menagerie—namely, an adult female from Ashantee, presented to the Society by H.M. the Queen in 1861.

"Mr. Sclater exhibited drawings illustrative of the external differences between these two wart-hogs, and also made remarks upon their well-known cranial and dental differences, which had been fully described by F. Cuvier, Van der Hoeven, and Owen, but which had not prevented Dr. Gray from uniting the two species in his recent catalogue of these animals."

This paper is illustrated by two woodcuts:—one the head of a male wart-hog with a large blunt nose, large canines, a large wart under the eyes, and very hairy ears, named *P. æthiopicus*; the other evidently the head of the female wart-hog figured on plate 20, conical, with a small nose, very small canines, a slight longitudinal ridge under the eye, and small, nearly naked ears—called *P. Æliani*.

Phacochœrus Æliani was first described by Dr. Rüppell, in his 'Zoological Atlas,' p. 61, tab. 65. If any one will take the trouble to turn to that description and figure, which is of a male, they will find it exactly agrees with the figure which Mr. Sclater has given of *P. æthiopicus*, especially in having the ears well covered with hairs, which he describes as being peculiar to *P. æthiopicus*. Therefore I considered *P. Æliani* of Rüppell and *P. æthiopicus* to be the same species—a conclusion to which I arrived after examining the original specimen received from Dr. Rüppell, which is now in the British Museum (this specimen, by-the-by, must have been overlooked by Mr. Blanford when he made his remarks on this animal), specimens from South Africa, and skulls from various parts of Africa; and I found that the various characters which had been proposed by F. Cuvier, Rüppell, and Sundevall to separate the wart-hogs of different

countries into two or more species did not present any permanent differences that could be relied upon; and I believed that the wart-hogs of different parts of Africa were only one species.

Indeed Mr. Sclater himself gives *P. Æliani* a very wide distribution, as he says it has been received by the Zoological Society from Zoulla, on the east coast, and Ashantee, on the west coast of Africa.

I believe that what Mr. Sclater has figured as the type of *P. Æliani* (Proc. Zool. Soc. 1869, tab. 20, and p. 277. f. 2) is only the usual form of the female of the African wart-hog. It is certainly not the *P. Æliani* (as distinguished from the *P. æthiopicus*) of Rüppell; but it may be a distinct species, the male of which we have not yet received, characterized by its naked ears; and as we have Mr. Sclater's authority that it is a different species, I would propose that it be called *P. Sclateri.*

On the Genus Saurocetes. By Dr. Burmeister.

(In a letter to Dr. J. E. Gray.)

I have lately received a most interesting specimen of a fossil from the tertiary strata of Buenos Ayres, which proves to be a new genus of *Zeuglodontidæ*, which I have named *Saurocetes* on account of its great resemblance to the gavial type of Crocodiles and its true cetaceous organization.

The animal must have been much smaller than the North-American *Zeuglodon*; the under jaw, which is the only part known to me, is, from the middle to the hinder end, only two feet long: the teeth are all alike; they have a single conoid corona, with two roots, which are not so distant from one another as those of the North-American *Zeuglodon.* I will very soon send you a description and figure of this interesting fossil.

Notice of a new Chilian Tortoise (Testudo chilensis). By Dr. J. E. Gray, F.R.S.

Testudo (*Gopher*) *chilensis.*

Shell depressed, dirty yellow; middle of the back flattened; areola central; nuchal plate distinct; marginal plates shelving, with a very short keel; front and hinder marginal plates reflexed, making a serrated edge. One pair of supranasals, a triangular frontal plate between the eyes; fore legs with a large spur at the elbow-joint, and numerous conical spines on the underside of the thighs, two of which are larger than the rest.

Testudo chilensis, Gray, P. Z. S. 1870, t.

Hab. Chili. Living in the Zoological Gardens.

Very like *Peltastes sulcatus,* but more depressed, and at once known by its broad fifth vertebral plate and narrower marginal plates.

Note on a new Night-Lizard (Phelsuma grandis) *from Madagascar.* By Dr. J. E. Gray, F.R.S.

Dark olive; chin and below white; a broad streak from the nostrils to the front of the orbit, one from orbit to orbit across the forehead, and a short longitudinal streak in front of it on the crown; four transverse rather irregular, short streaks, and six or seven unequal-sized round spots scattered in front or on the sides of them on the middle of the back. Tail reproduced, grey. Lower labial shields 5 . 1 . 5, with two small ones near the angle of the mouth, and some hexagonal plates below them. Length of body and head $4\frac{1}{2}$ inches.

Hab. Madagascar. British Museum.

Cross Fertilization and the Law of Sex in Euphorbia. By Thomas Meehan.

Mr. Charles Darwin's interesting observations on cross fertilization have opened a new world for original discovery. The list of plants which seem to avoid self-fertilization is already very large. I think *Euphorbia* may be added to the number. Certainly this is the case with *Euphorbia fulgens*, Karw. (*E. jacquiniæflora*, Hook.), which I have watched very closely in my greenhouse this winter. Several days before the stamens burst through the involucre, which closely invests them, the pistil with its ovarium on the long pedicel has protruded itself beyond, exposed its stigmatic surfaces, and received the pollen from the neighbouring flowers. The way in which the pollen scatters itself is curious. In most flowers a slight jar or a breath of wind will waft the pollen to the stigmas; but I have not been able to notice any leaving these flowers in this way; for as soon as the anther-cells burst the whole stamen falls from its filament-like pedicel and either drops at once on the pistils of other flowers or scatters its pollen-grains by the force of the fall.

This *Euphorbia* also furnishes another contribution to the theory of sex which I have advanced. The plan on which the male and female organs are formed is evidently a common one; and the only reason why some flower-heads have a pistil in the centre, and others are wholly staminate, is, that there is *greater axial vigour when the female flower is formed*. Whenever the common peduncle (below the scarlet involucre) is weak, a pistil never appears in that head of flowers. A few which seem strong also do not have them; but the great majority of the strong peduncles are those which bear the female blossoms. Another interesting fact is that the number of male flowers is less in those heads which also bear a female than in those which are wholly staminate. This seems to add to the point I made in my paper on *Ambrosia*, that after the flowers had been partially formed in embryo, and before the sex had been finally determined, the female flower, being primordially the stronger, has the power of absorbing the males or their partially formed elements into its system. It is certainly remarkable that in both these instances the number of male flowers should decrease in proportion to the existence or vigour of the central female one.

The male and female flowers of *Euphorbia fulgens* are formed

much alike. The female occupies the centre, and seems really but a prolongation of the main stem, on the top of which is an articulation from which the ovarium springs. The capsula readily falls from this articulation when mature. From the base of the female central peduncle spring weaker peduncles, colourless, appearing indeed almost like filaments, articulated at about the same height as the female, only above the point bearing a short filament and anther—the caducous part before referred to. No one can fail to see the correspondence of plan in these different parts; and I think that nothing but the favourable position in the direct line of axial vigour made the central flower a female one.

Cases occasionally occur in which a tolerably strong head of wholly male flowers will develop the central axis into a pedicel *almost as long and vigorous as those which bear female flowers.* But the flow of vital force (if I am correct in using the term) not being quite sufficient, the final goal of natural perfection in the female form was not reached. These cases do not occur often, but are well worth looking for, as they show so clearly the dividing line between the forces which govern the male or female sex.—*Proc. Acad. Nat. Sci. Philad.* 1870, p. 14.

Fossil Sponge-spicules.

We hear that Mr. Wm. Vicary, of Exeter, well known for his successful researches into the Silurian and Devonian fossil fauna found in the pebbles of Budleigh-Salterton, has discovered in the Greensand of the hills of Haldon and Blackdown respectively, in Devonshire, a number of beautiful sponge-spicules belonging to Dr. J. E. Gray's Corallispongia, in part (Dr. W. Thomson's order "Vitrea" and Dr. O. Schmidt's Hexactinellidæ), also to the Tethyadæ and Geodidæ. Mr. Parfitt, of Exeter, has described and illustrated them in a paper on the subject which he is about to read before the Devon Association for the Advancement of Science, Literature, and Art, at their annual meeting, to be held at Devonport on the 26th of July and following days.

The spicules appear to be in the remains of an arenaceous sponge, heterogeneously mixed up with the grains of quartz of which it was otherwise composed, thus representing the other kinds of sponges which existed in the locality then, just as the spiculo-arenaceous sponges of the present day bear indications of what other sponges exist in the localities where they now grow respectively.

On the Zoological Affinities of the Sponges.

Mr. Wm. S. Kent forwards us a letter to the effect that he has glanced through Mr. Lankester's criticism on his paper respecting Prof. Häckel's supposed relationship of the Sponges to the Corals. Mr. Kent having but recently returned from his dredging-expedition on the coasts of Spain and Portugal, and having had a pressure of work of higher importance to attend to, he has not had leisure to reply to Mr. Lankester's communication in the present number of this Journal. He looks forward, however, with much pleasure to answering it in our next.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

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XVII.—*Observations on the Whales described in the 'Ostéographie des Cétacés' of* MM. Van Beneden *and* Gervais. By Dr. J. E. Gray, F.R.S. &c.

The genus *Balæna* in the 'Ostéographie des Cétacés vivants et fossiles,' by MM. Van Beneden and Paul Gervais, being finished, and containing many observations on my three essays on the Cetacea, especially on the 'Catalogue of Seals and Whales in the British Museum,' published in 1866, I herewith send you some remarks upon it.

I believe that this beautiful and expensive work was undertaken and published at the cost of my esteemed friend Prof. Van Beneden; and the naturalists of every country are much indebted to him for his liberality in laying before them such an excellent series of figures of the skeletons of the Cetacea, especially those contained in the Paris and Louvain collections. It is to be regretted that he was not able to select a colleague in this work who had paid more attention to the osteology of this group and possessed a more philosophic spirit; for M. Gervais's previous short essays on the Cetacea of France, published in his 'Zoologie et Paléontologie de France,' showed a very limited knowledge of the subject; the text of this work has more the appearance of having been written to order than of being a labour of love; and M. Gervais has in this hasty compilation made several mistakes, which a more leisurely study of authors would have enabled him to avoid. He might, too, have improved the plates if he had adopted a more systematic distribution, after the manner used successfully by Mr. Flower in the osteology of the Sperm and other Whales.

In the preliminary history of the exotic species he has made very free use of the materials which I had compiled under

each species in the Catalogue of Whales; but he has worked them up into a short narrative, where I quoted the very words of the authors themselves. That he has compiled these observations second hand, is proved by the fact that in many cases he does not know the title of the work from which the materials are extracted.

As usual in many Continental works, there is a great inclination to regard all the species that are not in their museums as varieties of those they have: this leads them, when they receive examples of the species themselves, to describe them as new, which has produced much confusion in studying the geographical distribution of species.

I have been much blamed and ridiculed for applying the same rules to the study of recent whales, as distinguished by their bones, that palæontologists have been in the habit of using. In this work numerous species and even genera of whales have been established on very imperfect fossil skeletons, or even on a few bones; and, as I before said, I cannot see why, when one receives a single bone or blade of whalebone which, on comparison with the same bone or baleen of the different known whales, is found to be different from them, one may not conclude that it is a distinct species, characterized by the peculiar character of that bone or other part of the animal. Yet, because I have done so, while M. Gervais regards his fossil species as well established, he talks of the recent species so described as if they were not worthy of notice. Experience, however, has proved that the course I followed is the best for science: for example, having shown that there was a true whale with small baleen in Australia, thus causing the whale to be sought for, now we have the skull showing that it is a most distinct species and an entirely new form; and it has been the same with other species so indicated from small materials.

Great objection has been made to my having divided the whales into so many genera; but there can be no doubt that it has a great deal of influence on extending the knowledge of these animals; for it puts in a short compass the characters by which the species can be distinguished, and thus proves their distinctness. It is impossible not to see the influence of this system on the work before us, the authors of which have been most unwillingly forced to admit many species which were formerly denied: for example, naturalists (M. Van Beneden among the number) would persist in saying that there was no difference in the skeletons of *Balæna longimana* of Europe and of the Rorqual du Cap; but, after I had pointed out the character by which they were distinguished, M. Van Beneden wrote a

paper to prove that they were distinct; and in this work these distinctions are pointed out by the figures.

In the same manner, Eschricht did not believe in the existence of more than one species of Finner, until I convinced him by taking him to see the skeleton at Blackgang Chine; but in this work several species of *Megaptera* and *Balænoptera* are admitted.

It is to be remarked that M. Gervais gives no characters by which to distinguish the species from each other. We have only the habitat of the whale to guide us; and if that is wanting, we must read over each of the descriptions; whereas in my generic characters the most important characters which distinguish the different species may at once be seen.

The number of known whales has, since I began the study, very greatly increased; and I believe that as yet we do not know half of those that exist and are to be distinguished by very decided osteological characters.

It is curious that in this work the whalebone is only slightly referred to under one or two species, and never figured; and this is the more remarkable as the authors in their titlepage specially refer to the dentition of the different species. It is true that the whalebone is not the homologue of the teeth of other Cetacea, as it was formerly supposed to be; but it forms as good characters for the separation of the families, genera, and species as the teeth afford in other mammalia. Indeed it was the very evident difference existing in different kinds of whalebone that first convinced me that Cuvier and other Continental zoologists were misled when they attempted to prove that there was only one species of Hunchback or Finner whale.

These authors, at any rate, have reduced the number of genera to a minimum: thus they only admit three—*Balæna*, *Megaptera*, and *Pterobalæna*. The common whalers, two centuries ago, were far in advance of them on this head, as well as in the distinction of the different kinds of whalebone and of their adaptability to different economic purposes. They unanimously admit five distinct kinds of whales, which I am inclined to regard as distinct families, each containing several species living in different localities:—1st, the Whales proper, or Right Whales (Balænidæ); 2nd, the Scrag Whales (Agaphelidæ); 3rd, the Hunchbacks (Megapteridæ); 4th, the Finners (Physalidæ); 5th, the Pike-whales (Pterobalænidæ).

M. Van Beneden has discovered some abnormalities in the first rib of some of the common whales, and publishes them in the Proceedings of the Academy of Sciences of Brussels, 1868, p. 65. He figures two of these variations—one of *Balænoptera laticeps*, and the other of *Phocæna communis*. He

seems therefore inclined to believe that the differences between animals which have single-headed and double-headed ribs are mere accidental variations. I must regard this as a very large conclusion from very small premises. I believe (and, I think, on very good evidence) that there are certain whales in which the double head to the first rib is the normal form; and I should not the less be inclined to believe that this was not the case if I should find a whale of this kind that had the first rib on one side single-headed; for, no doubt, whales with single- and double-headed first ribs are each liable to such an accidental malformation, and it is to be remarked that there is a difference in the general form of the rib connected with the form of its head.

This theory of M. Van Beneden has induced him to regard the skeleton of the whale that was sent from the Cape by Mr. Horstock to the museum at Leyden, which has been called *Balæna antarctica* and *Hunterius Temminckii*, as only a variety of *B. australis*; but he even records many important differences between it and the two skeletons of *B. australis* in the Paris Museum: to be sure, its specific distinctness is opposed to one of his theories that only one species of whale is found in each district or locality. It is much to be regretted that preconceived theories should, as in this case, bias the judgment of a student of natural science. This theory seems also to have considerably interfered with the determination of the species of *Balænoptera*.

M. Van Beneden has republished in this work, with some alteration, his essay on and map of the distribution of species of whales, on which I published some observations in the 'Annals and Magazine of Natural History,' 1868, vol. i. p. 242.

I have studied the materials which this work affords, and I do not see any reason to alter the conclusions I came to; indeed they are more firmly established. There does not appear, from any of the habitats quoted in this work, any authority for believing that the whales do inhabit a belt across the oceans. To be sure, under *Balæna australis* of the Cape, he quotes the fact that a Right Whale has been recorded as found on the east coast of South America; but he does not cite any specimens or drawings to show that the Right Whale of the east coast of South America is the same species as that found at the Cape of Good Hope: indeed the only approach to any argument in support of this theory is that he believes *Balæna cisarctica* of the east coast of North America to be the same as *B. biscayensis*. As this last-named whale appears to take an important part in this theory, I will proceed to give its history.

Balæna biscayensis, as a zoological species, rests on very slender grounds. There were formerly, according to various authors, whale-fisheries in the Bay of Biscay and in the British Channel; but it is not proved that the Greenland whale had not a more extended distribution than at present, after it has been the object of capture for so many years, and, on the other hand, that the specimens that wandered far away from the usual habitat of the species would not become smaller, less fat, or more active than the others, which were better fed. The same argument may explain the difference observed by whalers in the size and form of the whales caught on the coast of Iceland and the east coast of Greenland. At the same time I would not deny that the whales of this latter place may not be a different species; but as yet we have not sufficient materials for separating and characterizing them.

In 1834 a female whale and its young were captured at St. Sebastian, and the skeleton of the young remained for some time at Pampeluna; it has since been removed to the museum at Copenhagen: and this is the specimen which has been named *Balæna biscayensis* by Eschricht, who gives an account of it in the 'Comptes Rendus' for 1860, and in the 'Actes de la Soc. Linn. Bordeaux,' vol. xiii.; and he thinks that he observed in the development of the various parts of the skeleton a difference from that which he had observed in the skeletons of *Balæna mysticetus*. But we must recollect that this was to support a theory that the latter whale was exclusively confined to the Polar seas and that the Right Whale of the North Atlantic must be different; but I do not see why, as the icebergs are annually carried out by the currents from the Arctic Sea to the North Atlantic, the Right Whale may not sometimes come down with them.

I have only Mr. Flower's note of the Pampeluna skeleton (Annals, 1868, vol. i. p. 244); and although it is now at Copenhagen, there is no description or figure of it in MM. Van Beneden and Gervais's 'Ostéographie des Cétacés.' The *Balæna biscayensis* of these latter authors is founded on what appear to me to be very incongruous materials, which would require a great stretch of credulity to believe that they belong to the same whale; I am sure that two of the specimens do not; indeed the authors seem to express a doubt with regard to one themselves. But the only ground on which they are united is that all the specimens were procured from the North Atlantic, together with the preconceived idea that only one whale can inhabit that region.

First, they rely on a mass of cervical vertebræ which probably came from the Mediterranean; it is figured by Lacépède,

tab. vii. fig. 1. But there is much uncertainty attached to these vertebræ. Lacépède observes:—"Le 30 ventôse de l'an 6 de l'ère françoise, un cétacé de vingt mètres de longueur fut pris dans la Méditerranée sur la côte occidentale de l'île Sainte-Marguerite, municipalité de Cannes, département du Var. Le citoyen Jacques Quine en fit un dessin, que j'ai fait graver; et bientôt après, les fanons, les os de la tête et quelques autres os de cet animal ayant été apportés à Paris . . . ." Although these bones are said to be those of one whale, they evidently belong to two genera: the head, the baleen, and probably the vertebræ (tab. vi. and tab. vii. figs. 2, 3, 4) all belong to a Finner (or *Balænoptera*); Cuvier refers to these bones under the name of "Rorqual de Méditerranée" (Os. Fossiles, vol. v. p. 383). The mass of cervical vertebræ, on the other hand, are, as observed by Cuvier (*ibid.* p. 368), the bones of a true whale; so that the authority for this mass having been found in the Mediterranean may be doubtful. These cervical vertebræ are figured by MM. Van Beneden and Gervais as those of *B. biscayensis*; they differ very slightly from the similar bones of *Balæna mysticetus*; and without other specimens, I should suppose them to be a mere individual variety of that species. At any rate, it ought to be called *Balæna mediterranea* rather than *biscayensis*, unless it can be proved that they are like the cervical vertebræ of the only skeleton of the whale found in the Bay of Biscay; and no such comparison is recorded. Cuvier, not knowing the cervical vertebræ of *Balæna mysticetus*, compared them with the bones of the Cape whale, *B. australis*, and correctly determined that they were distinct from those of that species.

Secondly, MM. Van Beneden and Gervais place among the materials which are supposed to belong to *Balæna biscayensis* a mass of cervical vertebræ which is in the British Museum, and which was dredged up on the coast of Lyme Regis (figured in the 'Catalogue of Seals and Whales,' p. 83, and copied in the 'Ostéographie des Cétacés,' tab. 7), justly observing that this mass of bone differs more from the vertebræ of *mysticetus* than the one figured by Lacépède and themselves. This mass is much more allied to the cervical vertebræ which I have named *Macleayius australiensis* (figured in the 'Catalogue of Seals and Whales,' p. 105. figs. 10 & 11, and p. 372. figs. 74 & 75), and, I am certain, belong to species very different from the one they have figured as coming from the Mediterranean. They also mention some lumbar vertebræ taken at Ostend, and some other bones which they think may have been found on the coast of the British Channel.

Thirdly, they regard the *Balæna cisarctica* of Cope as a

synonym of *Balæna biscayensis*, and figure the ear-bones of that North-American whale as those of this species. The origin of this reference is curious, and probably was the innocent origin of M. Van Beneden's theory of the distribution of whales. When Cope described this species, he said that it was probably the same as that of the Biscay whalers; but, as there is no figure or description of the whale which formerly inhabited the coast of the Bay of Biscay, he could not have any firm grounds for establishing the fact. However, MM. Van Beneden and Gervais adopt it as a certainty, and consider *B. cisarctica* of Cope a synonym of *B. biscayensis*, and take advantage of the presumed identity of the species found on the two sides of the Atlantic, in nearly the same parallel of latitude, to form a theory which they apply to the geographical distribution of the other whales. Mr. Cope has sent some specimens of the ear-bone of his *Balæna cisarctica* to M. Van Beneden; but as the ear-bones of the Biscay or even the Mediterranean whale are not known, they can in no way have any bearing on the question; they only prove that *Balæna cisarctica* is distinct from *Balæna mysticetus*; for the authors state, and the figure shows, that they are very much like the ear-bones of *Balæna australis* or the larger Cape whale.

I think that there is not at present any material to make out what the *Balæna biscayensis* of Eschricht is, and that the *Balæna biscayensis* of these authors is made up of the bones of various whales.

The number of ports on the European side of the North Atlantic, and the immense number of vessels of all kinds that are daily crossing and recrossing its surface, have long since deprived it of any place in which the adult whales could congregate, or any quiet bays where the females could retire to bring forth their young; therefore whales are as completely exterminated in that district as wild boars, wolves, beavers, bustards, and other animals are in Great Britain. It is not quite so bad on the American shores of the Atlantic; for there are still large and secluded bays where they can live and bring forth their young; and whales are more or less frequently captured there, but not so commonly as formerly, when there were whale-fisheries established there long after they had ceased off the eastern shores.

Maury, in his Charts, records the Right Whale as having been several times obtained in the mid-channel of the North Atlantic by the South-Sea whalers in proceeding on their voyages either out or home; and it has hitherto been supposed that these are whales which have wandered out of the

Arctic seas; but we cannot be certain on this point, as no remains of any specimens so taken are known to exist. These charts, I need not observe, give no support to M. Van Beneden's theory of whales inhabiting bands across the different oceans.

The whales of the North Atlantic, including the Mediterranean Sea, of which we have more or less reliable remains, are five in number. Thus on the east coast there are:—

1. *Balæna biscayensis*, Eschricht, which, I believe, is a *Cuvierius* with a double-headed first rib.

2. *Balæna biscayensis*, Van Beneden and Gervais—as distinct from *B. biscayensis* of Eschricht, resting on the mass of cervical vertebræ figured by Lacépède. Whether this is a distinct species or only a variety of *Balæna mysticetus*, there cannot be the slightest doubt of its being distinct from the following.

3. *Balæna britannica*, Gray, established on the mass of cervical vertebræ which is in the British Museum, before referred to, and which was dredged off the coast of Lyme Regis. The processes of the atlas and other cervical vertebræ are much more like those of the Australian Black Whale (*Macleayius australiensis*), and are very unlike the vertebræ of any other whale yet described; there is no doubt that they belong to a distinct species.

On the west coast there are also two very distinct species, which are so distinct from one another that Cope refers them to two different genera, the latter genus belonging to a section of *Balænidæ* characterized by having the cervical vertebræ free and only four fingers to the pectoral fin:—

4. *Balæna cisarctica*, Cope, who believes it to belong to the genus *Eubalæna*, and more allied to *B. australis* than to *B. mysticetus*; and the description of the cervical vertebræ at once separates it from the *B. biscayensis* of Van Beneden and Gervais, as they would have seen if they had read the description.

5. *Agaphelus gibbosus*, Cope. See Cope, Proc. Acad. Phil. 1868, p. 225, the Scrag Whale of Dudley, which is still now and then caught on the coast of America by the whalers, and is known by the same name as when it was described by Dudley. It is found in company with *Balæna cisarctica*, which is not uncommon on the same coast (see Proc. Acad. N. S. Phil. 1868, p. 223). It is, indeed, remarkable that so curious a whale, forming quite a distinct family from *Balæna*, of which there are a good many remains in America from which figures could be easily procured, is entirely left out in a work professing to give the osteology of the Cetacea!

For the sake of the symmetry of the theoretical distribution of whales, it is necessary that there should be a species ex-

tending across the North Pacific as the supposed *Balæna biscayensis* is said to extend across the North Atlantic: therefore, though MM. Van Beneden and Gervais doubt the existence of *Macleayius australiensis*, of which there are cervical vertebræ and, I believe, many other bones in the museum at Sydney, and *Balæna marginata*, which is so peculiar for the beauty and the small size of the blades of whalebone on which it was founded, and of which we have now got the skull, they consider established a species which they call *Balæna japonica*, allowing that the only authority on which their species rests is a porcelain model of a whale received from Japan, the existence of some blades of whalebone from the north-west coast, in the British Museum, and the existence of a fœtus of a whale in the museum at Copenhagen. But they do not inform us why they regard this fœtus as that of a Japanese whale, or give us any particulars of how or whence it was obtained.

I do not mean to deny that whales are abundant on the Japanese coasts; and we know well that they and the Americans and the English formerly did carry on whale-fishing in the North Pacific; but I believe that, instead of one whale being found in those seas, from the various names which whalers give to them, several species exist. Indeed Mr. Cope notices that several species, which he believes to belong to different genera, are found on the north coast of America; and we wait with anxiety for materials from the Japanese (who are excellent whalers) and from the American whalers, to make us fully acquainted with the whales which inhabit these seas. "Lumping" them all together into a single species, as has been done by these authors, is certainly not conducive to the extension of science.

I am very glad to see that we are becoming better acquainted with the whales of the North Pacific; for in a series of plates just published by Prof. Reinhardt, in Vid. Selsk. Skrivt. ser. 5. vol. ix. p. 1: Kjöbenh. 1869, he figures on pl. 1 a fœtus, $5\frac{1}{4}$ feet long, which he calls *Balæna japonica* (Lacép.), with the first rib not split, that is, single-headed, taken out of a whale caught on the coast of Kamtschatka by a Danish whaler, Södring. The skull and remaining skeleton are preserved in spirits in the University museum of Copenhagen. The skull is figured; and one of the figures is very interesting, as showing its original segmentation. This specimen is doubtless the one quoted by MM. Van Beneden and Gervais, and referred to above. But, unfortunately, the very undeveloped state of the skeleton of this fœtus does not afford us any character to distinguish it from the other whales.

The whales of the northern part of the Pacific have had names enough given them:—

1. *Balæna Kuliomoch*, Chamisso (Nov. Acta Natur. tab. 7. fig. 1; *Balæna culammak*, Pallas, Zoogr. Ross.-Asiat. i. p. 288; Cope, Proc. Acad. N. S. Philad. 1868, p. 225, 1869, pp. 17 & 40, f. 4), is from a wooden model made by the Aleutians as a whale of their seas.

2. *Balæna japonica*, Lacépède, Mém. Mus. vol. iv. p. 473.

3. *Balæna lunulata*, Lacép. Mem. Mus. iv. p. 475.

These two are from Chinese or, rather, Japanese drawings.

4. *Balæna australis*, Temminck, Fauna Japonica, Taf. 28 & 29 (not Desmoulins). *Balæna Sieboldii*, Gray, Ann. & Mag. Nat. Hist. 1864, vol. xiv. p. 349. From a model made by the Japanese in porcelain clay.

5. *Balæna japonica*, Gray, Zool. Erebus & Terror, p. 15, tab. 1*. f. 2. *Balæna alutiensis*, Meyer, Van Beneden (Bull. Acad. Belgique, xx. 1866, no. 14.) Both from the north-west-coast whalebone of commerce, which is quite distinct from the South-Sea whalebone, brought from the Cape.

6. *Balæna japonica*, Eschricht, Vid. Selsk. Skrivt. ser. 5. vol. ix. 1, 1869. From the skeleton of the fœtus of a whale caught on the coast of Kamtschatka.

7. *Balæna mysticetus*, Cope, Proc. Acad. N. S. Philad. 1869, pp. 17 & 35. The Bow-headed Whale, Scammond: American whalers. Behring's Straits.

These must include more than one species; and there can be no doubt of the next being distinct, for it is a *Scrag Whale*.

8. *Rhachionectes glaucus*, Cope, Proc. Acad. N. S. Philad. 1869, pp. 17 & 40, fig. 8. *Agaphelus glaucus*, Cope, *ibid.* 1868, p. 225. The Californian Grey Whale. St. Francisco.

Cope observes that a species of *Agaphelus* exists in the Kamtschatkan seas, according to Pallas, who, however, derived his information solely from models made by the Aleutian islanders; he called it *Balæna agamachschik*. Dr. Cope observes, "Dr. Gray, in his Catalogue of Whales, truly indicates it as a genus unknown to him" (see Proc. Acad. N. S. Philad. 1868, p. 226). Mr. Cope's account of this whale is very interesting; and there are several remains.

In this work the number of the species of the genus is limited to five—*Balæna mysticetus*, *B. biscayensis*, *B. japonicus*, *B. australis*, and *B. antipodarum*; but the authors believe there may exist another species that extends from the east side of the Cape of Good Hope to Australia. This theory evidently has had considerable influence in determining what species they should admit as distinct, and what they should regard as varieties. They ignore the existence of two species of whales at the

Cape, of two species which I have described as being found in Australia, and the existence of two well-established species which are found on the coast of New Zealand; to be sure, one of these (*Neobalæna marginata*), as if in opposition to M. Van Beneden's theory, instead of being found in a belt between Australia and the east coast of the Cape of Good Hope, is common to West Australia and New Zealand.

It is very curious that M. Van Beneden did not discover that my *Macleayius australiensis* is the Right Whale of Australia, which he regards as at present unknown, and at another place mentions that it may probably be *Neobalæna marginata*, which has whalebone only about two feet long, whereas the Black Whale of Australia has whalebone five or six times that length, or it would not be worth the whalers collecting for sale. M. Gervais erroneously states that this genus and species was founded on an error, caused by a photograph; but that is entirely a mistake, caused by the very carelessness in compiling to which I have before referred. It is very true that I did at first think that the genus *Macleayius* was peculiar for having the atlas free from the rest of the cervical bones; when I discovered the error of this opinion, and received additional photographs, I stated, "but still the form of the atlas is so distinct from any other known genus of Balænidæ, that I believe the Australian Right Whale will be a distinct genus, to which the name of *Macleayius* may be appropriately applied, and it is, no doubt, a true *Balæna*" (Gray, Cat. Seals and Whales, p. 371). M. Gervais further says, with regard to this whale, "Nous ne voyons pas de motif de ne pas rapporter cette région cervicale à la *Balæna antipodarum* en attendant que l'on ait des renseignements précis sur ses caractères distinctifs;" but I think that if any one will compare M. Gervais's figure of the cervical mass of *B. antipodarum*, given in pl. 3. figs. 4 & 5 of his work, with the figures of the cervical mass of the Australian whale figured in my Catalogue, p. 105. f. 10, 11, p. 372. f. 74, 75, he will find that little reliance can be placed on M. Gervais's remark. In the New-Zealand whale the upper lateral process of the atlas is narrow, like the same process in the Greenland and Mediterranean whales, while in the Australian whale this process is particularly high and wide; and the lower lateral processes are equally distinct and peculiar. And I think that the mass of cervical vertebræ dredged up at Lyme Regis, and figured in my 'Catalogue of Seals and Whales,' p. 83. f. 3, which M. Van Beneden refers to *B. biscayensis*, and at the same time says that it is so different from *B. mysticetus*, is the most nearly allied to the cervical vertebræ of the genus *Macleayius*, and

which I call *Macleayius britannicus* after the Mare Britannicum of the ancient geographers. I think I have proved that M. Van Beneden's theory of geographical distribution of whales is entirely unsupported by facts.

XVIII.—*Conclusion of the History of the Wasp and* Rhipiphorus paradoxus, *with Description and Figure of the Grub of the latter.* By Andrew Murray, F.L.S.

[Plate XIV.]

When I bade adieu to this subject some months ago, I did so with the promise that, if further investigations by myself or others should show that I was mistaken in the views I had taken up, I should readily and handsomely acknowledge my error.

I have now to redeem my promise; and notwithstanding the natural reluctance which every one feels to acknowledge that they have been mistaken, I make the acknowledgment with pleasure, because it enables me to do an act of justice to one, the accuracy of whose observations I had impugned, and to withdraw any doubt I had expressed as to their reliability. Not that I ever in the remotest degree felt or expressed any doubt as to the genuineness of his observations; but one may be a very truthful and yet a very inaccurate observer; and this was what I had supposed Mr. Stone to be, and what I am happy now to be able to say was a very unjust supposition. Another alleviation to the wound which my *amour propre* may be supposed to have received, is the satisfaction of having, as I think, cleared up if not all the unknown and doubtful points in the history of the insect, at least those which last year prevented the question of parasitism being brought to a definite conclusion.

Through the continued kindness of Miss Eleanor Ormerod I have this year been enabled to examine some combs well supplied with *Rhipiphori* at a less advanced stage than those which I studied last year, as well as to profit by her independent observations. Last year the *Rhipiphori* were mostly in the state of the perfect insect or chrysalis before I saw them; and I did not then know the larva. The one or two which I did see in the doubly tenanted cells which I described in my first paper on the subject, I mistook for immature pupæ; and when Mr. Smith showed me Mr. Stone's

specimens I did not fully appreciate the difference between them and the wasp-larvæ, the spirits in which they were preserved having destroyed much of their character. To appreciate the difference between them and the wasp-larvæ—in fact, to make their acquaintance thoroughly, one must see them alive and in all their degrees of development.

Mr. Stone's description, too, which is the only published one we have, does not at all enable one to distinguish them, his most prominent characters being two, which are shared by the wasps themselves—namely, a transparent dark line down the back, and the contents of the body seen through the skin looking like curds. It is true that these characters are more marked in the *Rhipiphorus* than in the wasp; but as they vary much in degree in the latter, no description, taking them for characters, could ever enable one who has not himself seen them to be sure whether his wasp-grubs were *Rhipiphori* or not. There are, however, good and sufficiently recognizable characters by which to know them; and to enable the reader to do so I append a full description, with figures, which will supply this lacuna in entomological knowledge.

The opportunities I have had this year have made me thoroughly familiar with them; and the first fact which I have thereby ascertained, or at least become convinced of, is that *Rhipiphorus*-larvæ are never to be seen in open cells. All our proposed plans for feeding and watching them have therefore fallen to the ground. I have found them abundantly in closed cells, but never once in an open cell; and the explanation is simply that the *Rhipiphorus*, as maintained by Mr. Smith, Dr. Chapman, and others, is a parasite, not a guest, and that it only attacks the wasp-grub in cells where it has done feeding and is about to commence to spin up the lid of its cell. This, no doubt, involves the admission that the *Rhipiphorus* performs the extraordinary feat of growing to its full dimensions upon no more food than an insect no longer than itself. Such a power of assimilation seemed to me incredible; but, like many other facts in natural history which at first seem to us incredible, it turns out not only to be true, but to be capable of natural explanation.

In the first place, I believe that I have seen the *Rhipiphori* in every stage in the closed cell, from the egg to the perfect insect. As to the egg and earliest stage, I express myself with a certain amount of diffidence, because I have only one observation of it to rely on; and although in an ordinary case that might be sufficient, especially where I have the specimen preserved in spirits to show as a *pièce justificative*, it is necessary in dealing with these insects to proceed with extra caution,

because in the allied genera *Meloë* and *Sitaris* the larva has been ascertained to go through some extraordinary evolutions in its earlier stages, and at first to appear in a very different form from that which it ultimately assumes.

According to M. Fabre, the only naturalist who has yet observed these changes in *Sitaris*, its life-history has eleven events:—

1. The egg is laid in the galleries of the *Anthophora*.

2. A little larva is hatched with six serviceable legs, which remains in its birthplace without food or change of size from October to April.

3. In April it becomes active and attaches itself to the males of *Anthophora* when they emerge from their cells, which they do before the females.

4. From the male it passes to the female *Anthophora*.

5. From the female it passes to its egg, on which it springs as the female lays it on the surface of the honey on which it was to feed, where it sits as on a raft.

6. It then eats up the egg, which takes it eight days.

7. Seated on the empty shell, floating on the honey, it now undergoes a metamorphosis from its previous slim active carnivorous form to a white fleshy grub, which is no longer carnivorous, but feeds on honey, and is so organized as to float on the surface of the honey, mouth below, spiracles above.

8. After the honey in the cell is done, it changes its skin and passes into something under a corneous envelope like the pupa of a fly.

9. It moults again and once more resembles its second stage (I presume the grub-state; but as it is only said to resemble it, not to revert to it, there may be some difference intended: nothing is said as to its food or feeding in this stage).

10. It then passes into the ordinary pupa-state.

11th, and lastly. It becomes the perfect insect*.

Without giving absolute faith to all these changes, there is obviously something sufficiently mysterious in the early life of all these creatures to require great care in our observations, and that we should mention every circumstance that strikes us, whether we are certain of its relevancy or not.

Keeping this in view, I speak with extreme caution and, even, doubt of the egg and the earlier stage of the *Rhipiphorus*. What I observed was this:—

In examining the closed cells of a piece of Rhipiphorized comb, I found the easiest way of opening them and getting a view of their interior was by tearing out the sides instead of

* See account of M. Fabre's writings in 'Natural History Review,' 1862, p. 129, from which I have taken my information.

clipping off the lids of the cells. On so opening them I usually pulled out the larva inside; and in many I found the *Rhipiphorus*-larvæ in various stages, bigger or smaller than the wasp-grub, as the case might be; and the *Rhipiphorus* is so firmly attached by its mouth to the wasp-grub, that both, as a matter of course, came away together as one body. In one cell, however, it was not so. In it I saw what appeared a very minute *Rhipiphorus*-larva, in the usual position of these creatures (lying across the throat of the wasp-grub). On pulling out the wasp-grub, the *Rhipiphorus*-larva did not in this instance come with it; it stretched a little, as if there were two points of adhesion, one to the wall of the cell, the other to the wasp-grub; and as I withdrew the latter the adhesion to it gave way, and the *Rhipiphorus* remained adhering to the cell-wall close below its lip (see Plate XIV. fig. 1). It collapsed back upon it and assumed a somewhat irregular rounded form, and seemed attached to the cell-wall by a broad pedicel (fig. 2). It strikes me that this may have been the *Rhipiphorus* in an intermediate state between the egg and the larva—still egg at the base, and, as such, adhering to the place on which it was laid, but struggling into life at the head; and possibly the mandibles had already appeared and made some slight incision in the hide of the big wasp-grub, although I could make out neither mandibles nor incision. In the wasp and in many other insects (as the flies for example), probably in all that have flexible skins, the eggshell is not broken in hatching, but becomes the first skin of the larva. The stretching of this object and its adhesion to the grub is the only ground I have for supposing it to be any thing but simply the egg; that adhesion and consequent stretching might have been due merely to the continuity of the two soft bodies touching each other. Now that they (both grub-cell and egg) have been a fortnight in spirits, the egg is merely a little round white dot about the size of a pin's head, still adhering to its place on the cell-wall. At first I thought I could trace something like the lineaments of the larva through the eggshell or skin; but that was, perhaps, imagination.

If I am right in the interpretation of this, the egg is laid, not on the body of the wasp-grub, but on the wall of the cell just within its lip. The usual position of an egg laid by the wasp is shown in fig. 16.

How long it remains in the egg-form before attacking the wasp-grub, I do not know. The specimen above-mentioned must have been laid at least two days before it reached me. It cannot remain very long, however, before being hatched; for it is a very common characteristic of the closed cells in

which the *Rhipiphori* are to be found that the lid of the cell has a hole, or a thin spot, or other defect, in the middle: it is not always observable, nor perhaps even in the majority of instances; but still it is so very often, and I believe the lid in the Rhipiphorized cells is never so strong as in the others. The explanation of it seems to be, that the *Rhipiphorus*-grub attacks the wasp-grub before it has completed its lid, and does it sufficient injury to prevent its properly finishing it. Where the lid has been finished at all, the egg has probably been laid just before the grub began to spin up; where it is unfinished, it may have been laid a day or two before.

This imperfection of the lid is of essential advantage to the *Rhipiphorus* afterwards. I think in one of my former papers I drew attention to the fact that the perfect insect made its way out of the cell in quite a different fashion from the perfect wasp. The wasp cuts its way out through the parchment-like lid with its strong mandibles; but the mandibles of the perfect *Rhipiphorus* are small, weak, and inadequate to the purpose, and it never uses them; it bursts its way through by main force, pushing the crown of its head against the lid until it gives way. If the lid were of normal strength, the *Rhipiphorus* might never get out, but die entombed in the chest in which it had incautiously allowed itself to be locked; and the lid would be of normal strength if the egg of the *Rhipiphorus* were not soon hatched and the wasp-grub attacked before the lid is completed. Possibly the increased heat caused by the closing the cell may start the egg more rapidly than would otherwise have been the case, so that it will be hatched as soon as every thing is ready for it. It is an instance of adaptation of mode of life to subsequent requirements, which looks very analogous to adaptation of structure to purpose.

In the next place I found a number of instances where the *Rhipiphorus*-egg had apparently only quite recently become a grub. In two instances it was lying across the vertex of the wasp-grub, as shown in fig. 3; but more generally it fastens itself obliquely across the breast or shoulder, as a woman carries a child, as in fig. 4, sometimes lying to one side, sometimes to the other, but, so far as I have noticed, the head always over or to the shoulder (baby-fashion), and the tail to the tail (see fig. 4).

The effect of this, I may observe in passing, is to keep the grub with its head towards the mouth of the cell, a position it could not have obtained had it commenced its repast with its head to the tail instead of to the shoulder. This at-

titude it could not maintain if it *ate* the grub, that is, tore it in pieces and masticated it; but it does not do that; it sucks it, and never removes its mouth from the spot on which it first fastened. As it sucks it increases in size, and the volume of the wasp-grub diminishes, and the skin contracts and shrivels, keeping the victim always at the mouth of the parasite. So marked is this shrivelling, that latterly, in opening the sides of the cells in search of *Rhipiphori*, I could, the moment I got a glance at the texture of the body of the wasp-grub, and before I saw the *Rhipiphorus*, always tell whether it had been attacked by one or not. When not attacked, the wasp-grub has a certain amount of glistening plumpness, although not quite so much as the feeding larva in open cells. After it has been attacked, it becomes duller and opaque or finely shagreened, as it were, and a little more yellowish.

The rate at which the *Rhipiphorus* consumes the wasp-grub, although very rapid, is, according to my observation, not quite so much so as in the instance recorded by Mr. Stone. The nest came into our possession on the 27th of July. On the 28th I only found one egg (as above-mentioned); all the rest were hatched, most of them very recently, the smallest being about a line in length. On the 31st of July the smallest were nearly 3 lines in length. On the 2nd of August something went wrong with my specimens, and they made no further progress; they began to shrivel and change colour, and I bottled them; but from watching the more advanced specimens when fresh, I saw that after they have become larger than their victim their progress is more rapid than before. That represented in figs. 5, 6, and 7, from which the relative size may be estimated, had completely consumed its victim on the third day thereafter, but not on the second.

I cannot say how far the unnatural condition in which my specimens were may have retarded the progress of the feeding; at first it did not seem to affect them; but, judging from what I saw, I should say that from eight to ten days would be the ordinary time that the *Rhipiphorus* takes to consume its victim; and adding three or four days for the egg, the whole business would seem to take about a fortnight.

As the *Rhipiphorus* sucks, the wasp-grub at last, to all appearance, entirely vanishes. It does not do so absolutely, however; for if the chin of the mature *Rhipiphorus*-grub, now solitary by itself, be lifted up from its breast (on which it constantly rests), there will be found (at least, I have found it in all my experiments) a tiny scrap of yellowish-brown animal matter,

in which, under the microscope, are to be distinguished a pair of wasp-grub's mandibles. It is the unconsumed part of the skin, and doubtless what Mr. Stone saw, instead of the exuviæ of former tenants adhering to the tail as I had supposed.

I do not think the above facts are explicable on any other view than that I have above stated; and it removes or explains many other difficulties which I last year thought unsurmountable. On looking back at the arguments I then used, they still seem to me, for the most part, sound, all but the premises. These unhappily have the slight defect of being erroneous. I started by assuming that where two eggs were found in a wasp's cell, one of them must belong to the wasp, the other to the *Rhipiphorus*; and I reasoned out its life-history as a necessity from that; and were that so, I still think it was a necessary course of life. But I now see that the two eggs have nothing to do with the *Rhipiphorus*; they are both wasp's (a mere instance of misplaced zeal on the part of the wasp-mother), of which one is hatched, the other dies. No double tenancy, I venture to say, ever occurs except when a *Rhipiphorus* is present. The instance of a reversed grub to which I drew attention in my first paper, which I then thought might be connected with *Rhipiphori*, does not now, with our fresh information, seem to belong to it. Its explanation is still to seek; but of the other facts, the only one which seems to require explanation is how the *Rhipiphorus*-grub can grow as big as a wasp upon no more food than the body of a single wasp-grub. The explanation seems to be this. The wasp-grub has already assimilated all that is necessary to make a body of the bulk of a *Rhipiphorus*. The materials needed by both are the same. All that is wanted, then, is that the *Rhipiphorus* should build up its frame of the matter already assimilated by the wasp; in other words, it transfers the assimilated matter into a new shape, and no more. It is an extreme instance of what we know in our own case. We require a vastly greater amount of vegetable matter for food than animal matter, and simply because the latter is, in a great measure, ready assimilated to our hand. It must be the same principle carried to its extreme that enables the *Rhipiphorus*-grub to do so much upon so little: and in proof of this I may note that it makes almost no excretions; a little, very little, scrap of yellowish-brown jelly, scarcely larger than two pins' heads, resting on the abdomen is all that has dropped from it in the whole course of its life.

The fact that the *Rhipiphori* which come out of the queens' cells are (like the queen wasps) larger than the other *Rhipiphori*, but indifferently male and female, is doubtless an-

other phase of the same phenomenon. They have had more to feed upon; and as apparently they assimilate or remodel almost the whole of the stuff in the wasp-grub, their bulk bears a relative proportion to the amount of food consumed.

Description of Larva of Rhipiphorus paradoxus.

In its earlier stages it is almost crystalline and transparent; as it grows older it becomes like highly polished cream-coloured marble (especially on the abdomen), except a longitudinal stripe up the back, which remains transparent and allows the eye to penetrate into the interior of the body between the two more solid sides—giving it, when alive, as it were the appearance of a dark stripe. When preserved in spirits, this line of thinner skin sinks and shrinks, so as to make a furrow; but when alive the furrow is only apparent, not real. Looking through this, and generally through the skin, when the insect is alive, a conglomeration of shifting curd-like matter is to be seen, very much as in the wasp, only whiter and more solid.

At first its head is not so much inclined; but in the perfect larva it is bent down upon its breast. Its form has grown into the attitude which its continued position in feeding has prescribed for it. Figs. 8 and 9 show its attitude at these respective periods. When full-grown, the head cannot be forced back or the insect made to lie flat on its face, being tied down, as it were, by the thoracic segments being shorter on the underside than on the upper.

The whole body is soft and concolorous, and when mature is about 5 lines in length. It consists of thirteen segments; but the two anal segments are scarcely distinguishable from each other, and in some cases the three last may be confounded as one.

The head is very small, projecting like a knob from the first thoracic segment. It isso small that it might be mistaken for a large labrum.

There are no ocelli or eyes, but a faint almost imperceptible narrow subcutaneous streak of brown indicates (as in the wasp-grub, but not nearly so distinctly as in it) the inner margin of the future eye. There is a faint longitudinal whitish line running up the middle between them.

The labrum is rounded and tumid at the apex; when seen from below, it is obtuse (see figs. 10 & 11).

The mandibles are round and stout at the base, rapidly terminating in a very obtuse awl-shape with a very sharp and minute point, which is not central, but more to the front than the middle.

There are no maxillæ.

There are no antennæ or indication of antennæ.

There are no palpi or indication of palpi.

The labium is not defined.

The thorax is rather developed and bears on each segment on each side of the dorsal line a prominent round crystalline knob with an accessory external addition on the last two segments. The first segment is turned vertically downwards, the second is obliquely placed; the last is horizontal at the top, where the head is in most other insects.

Each segment of the thorax bears two short legs—those on the first segment the smallest, on the last the largest.

The legs consist of three short rapidly tapering segments. They are very short, very obtuse, each segment diminishing as it proceeds from the body, and all starting from the swollen rounded mammiform margins of the thoracic segments. The underside of the thorax is concave.

The segments of the abdomen (with the exception of the last two) are very deeply and distinctly separated; the first segment has dorsal knobs like the preceding thoracic segment, as large but not so crystalline; the second segment has only an indication of them; the rest are without them. Down the back runs the transparent septum already spoken of. The stigmata are very well marked, lying in a pit a little behind the hollow between the segments on each side of the back near the margin. In the hollow itself, just in front of the stigmata, is another, similar pit. On the underside of the abdomen the segments are more or less interrupted in the middle; on each side of it there is a pit in the hollow as on the back. The last two segments are short, scarcely divided, and slightly reverted.

It is unnecessary to describe the pupa, which is merely a colourless undeveloped phantom of the perfect insect, more or less like it the nearer it is to exclusion.

EXPLANATION OF PLATE XIV.

Fig. 1. Section of closed cell with lid torn off, showing what I suppose to be an egg of *Rhipiphorus* near the mouth (slightly magnified).

Fig. 2. The supposed egg in fig. 1, more magnified.

Fig. 3. Wasp-grub taken from a closed cell, with a young *Rhipiphorus* fastened across its head.

Fig. 4. Wasp-grub taken from a closed cell, with a young *Rhipiphorus* in its most usual position, lying fastened across its breast like a baby.

Fig. 5. *Rhipiphorus* with wasp-grub nearly consumed; side view; magnified four times.

Fig. 6. The same; three-quarters front view.

Fig. 7. The same; three-quarters back view.

Tuffen West lith.

Rhipiphorus and Wasp larva.

Fig. 8. Mature *Rhipiphorus*-larva after it has finished eating the grub; side view; magnified seven times.
Fig. 9. The same; front view: magnified seven times.
Fig. 10. Head of *Rhipiphorus*-larva, much magnified.
Fig. 11. The same, looking down on mouth, still more magnified.
Fig. 12. Mouth, showing mandibles looked-at end on.
Fig. 13. Mandible, side view.
Fig. 14. Legs, much magnified.
Fig. 15. The same, still more magnified.
Fig. 16. Cell of wasp, showing ordinary position of wasp's egg.
Fig. 17. Wasp-grub; back view; magnified four times.
Fig. 18. The same; side view; magnified four times.

XIX.—*On some new or little-known Shells &c. of the Crag Formations.* By ALFRED BELL.

HAVING in the course of the last few years succeeded in obtaining from the Upper Tertiaries of Great Britain a considerable number of species of shells, Echini, &c. that have not yet been recorded, the following list of those procured from the different Crags may be useful to others who are interested in the study of these deposits.

Those species marked thus * are new to the Crag fauna (and will be figured shortly from these or other specimens); the others are simply new to the strata to which they are referred.

The terms C. C., R. C., N.C., Chil. ser. are used as contractions of Coralline Crag, Red Crag, Norwich Crag, and the Chillesford series respectively.

Helix hispida, Linné. R. C. Butley.

**Melampus fusiformis*, Wood, MS. (n. sp.). Shell cylindrically fusiform, smooth; spire pointed, finely striated lengthwise; whorls 6–7, columellar plaits or folds 2; teeth on inner side of outer lip 2. Long. $\frac{1}{2}$ in.

Loc. N. C. Thorpe, Suffolk.

Murex erinaceus, L. R. C. Butley. This, a specimen from Harwich (recorded by Mr. Webster), and another from the N. C., Bramerton, are the only shells of this species mentioned as having been found in the Crag. The former shell (a fragment) is now in the Mus. Pract. Geol., Jermyn St.; both the others are lost.

Columbella sulcata, Sow. C. C. Sutton.

**Admete Reedii*, Bell (n. sp.). Shell ovately fusiform; whorls 6–7, obtusely angulated towards the top, forming a shoulder; spire tapering, suture slight; inner lip reflected; plaits on columella indistinct, finely striated; costæ hardly perceptible. Long. $\frac{6}{10}$ inch.

Loc. C. C. Orford. One specimen in the collection of W.

Reed, Esq., of York, and another in that of E. Cavell, Esq., Saxmundham, are all that I have seen of this handsome shell.

Pyrula reticulata, var. *cancellata*, Grateloup. R. C. Foxhall, Waldringfield.

Fusus altum, Wood. The same as *Buccinum cretaceum*, Reeve. *Hab.* Canada, Labrador, &c. Specimens from the Canadian Postglacial Clays present the same decorticated appearance as the Crag shells.

—— *gracilis*, DaCosta. The Crag shell has been referred by Mr. Jeffreys to an American form which he proposes to call *F. curtus*, a name already assigned to an Eocene species. As the American shell (*F. islandicus* of Gould, not Chemnitz) is not known to be living elsewhere, I would suggest the name *F. americanus* as being a suitable one for it, leaving the Crag shell, from which it differs in many points, its provisional name till its affinities are better worked out. Mr. Leckenby possesses a fragment of a *Fusus* identical with *F. americanus*, obtained from the Bridlington Crag.

**F. Jeffreysianus*, Fischer. R. C. Walton? (Wood), Waldringfield and Sutton. Unfortunately most of the Crag *Fusi* (of the *gracilis* type) have lost their *apices* and part of the outer coating, rendering their correct assignation very perplexing.

*—— *Largillierti*, Petit. R. C. Sutton. *Hab.* Newfoundland.

*—— *Sarsii*, Jeffreys. R. C. Waldringfield.

*—— *propinquus*, Alder. Bridlington Crag. (Brit. Mus.)

Buccinopsis Dalei, Sow. Chil. ser. Easton Bavent.

*—— *pseudo-Dalei*, Wood, MS. (n. sp.). Shell somewhat resembling *B. Dalei*, ventricose, tumid, thick, smooth, or nearly so; base of outer lip expanding; pillar lip twisted, curving outwards at base and reflected; canal short and open; whorls 4–5 (apex concealed by nullipores). Long. $2\frac{3}{8}$ in., lat. $1\frac{6}{8}$.

Loc. C.C. Orford.

In a very large series of *B. Dalei* from the C. & R. Crags I am unable to find a specimen similar to the above; and Mr. Leckenby has seen nothing to which it can be compared amongst the recent shells of the same species, of which he has a large number.

**Buccinum ciliatum*, Fabr. R. C. Butley.

*—— *grœnlandicum*, Chemnitz. R. C. Butley.

*—— *glaciale*, Chemnitz. Near Woodbridge. (Acton Coll.)

Nassa conglobata, Brocchi, = *Desmoulea abbreviata*, Gray. *Hab.* West Africa.

Nassa propinqua, Sow., = *N. trivittata*, Say. *Hab.* North-east America. Chil. ser. Easton Bavent.

—— *reticosa*, Sow. Chil. ser. Easton Bavent.

*—— *variabilis*, Phil. R. C. Butley (? var. *Cuvierii*, Payraudeau).

Terebra canalis, Wood. R. C. Waldringfield.

Defrancia linearis, Mont. R. C. Butley.

—— *Philberti*, Michaud. R. C. Walton.

*—— *hystrix*, Jan. R. C. Walton.

**Pleurotoma lævigata*, Phil. R. C. Walton. The shell figured under this name in the Mon. Crag Moll. is of another species.

—— *intorta*, Brocchi. This may be the *P. callosa*, Kiener. *Hab.* Senegal.

*—— *pyramidalis*, Ström. N. C. Thorpe, Suffolk.

—— *rufa*, Mont. R. C. Butley.

*—— *violacea* ?, Mighel et Adams. N. C. Thorpe, Suffolk.

**Cypræa dertonensis*, Michelotti. R. C. Waldringfield.

Natica catenoides, Sow. C. C. Sutton. Chil. ser. Easton Bavent.

—— *cirriformis*, Wood. R. C. Sutton and Waldringfield.

—— *occlusa*, Wood. R. C. Butley. N. C. Norwich. Chil. ser. Easton Bavent.

**Amaura candida*, Möller. R. C. Butley.

Pyramidella læviuscula, Wood. R. C. Walton.

Odostomia acuta, Jeffreys. R. C. Walton.

—— *conoidea*, Brocchi. R. C. Walton.

Chemnitzia costaria, Wood. R. C. Butley.

—— *densecostata*, Phil. R. C. Walton.

**Eulimella acicula*, Phil. R. C. Walton.

**Eulima distorta*, Deshayes. R. C. Walton.

*—— *intermedia*, Cantraine. R. C. Walton.

Triforis granosa, Wood, = *Cerithium boreale*, M'And., = *C. Macandrei*, Beck. *Hab.* Norway. R. C. Walton.

—— *perversa*, Linné. R. C. Walton.

**Cerithium reticulatum*, Da Costa. R. C. Walton.

—— *trilineatum*, Phil. R. C. Walton.

Cerithiopsis metaxa, Delle Chiaje. R. C. Walton.

Aporrhais pes-pelecani, Linné. N. C. Thorpe, Suffolk.

**Scalaria pseudo-scalaris*, Brocchi. Chil. ser. Sudbourn, near Orford.

—— *subulata*, Nyst. R. C. Walton.

*—— *Turtonis*, Leach. Chil. ser. Sudbourn, near Orford.

—— *varicosa*, Lamarck. R. C. Walton, Waldringfield, Sutton, &c.

Rissoa Stefanisi, Jeffreys. R. C. Walton.

Rissoa zetlandica, Mont. R. C. Walton, Waldringfield.
* *Trochus granulatus*, Born. R. C. Walton, Butley, &c.
* *Fissurella costaria*, Basterot. C. C. Sutton. R. C. Waldringfield.
* *Puncturella noachina*, Linné. C. C. Sutton.
* *Capulus? incertus*, Bell (n. sp.). Shell forming a flattened cone, with depressed and overhanging apex, which is nearly on a level with the margin. Volution twisted, inclining to the right. Opening truncated (with a slight inflexion) on the right side; left side expanded, sloping *downwards* from the top to the centre, and thence contracting towards the base. Sculpture 6–9 strong ribs or flexures on the left side, curving lengthwise and downwards from the apex. Surface finely striated all over; lines of growth very distinct. Long. $1\frac{1}{8}$ in., lat. $\frac{15}{16}$ in.

Loc. R. C. Waldringfield.

Two or three specimens are all that I have seen of the above shell, all being about the same size. This species and *Capulus militaris*, var. *partim-sinuosus*, Wood, also strongly flexured or ribbed, probably belong to the genus *Brocchia*, Bronn (type *Patella sinuosa*, Brocchi), also with these same flexures on the left side, but running in a contrary direction. Mr. Wood's suggestion that these are caused by the shell adhering to a *Pecten*, appears to me inadmissible, because the flexures are always in each species in one direction.

Capulus obliquus, Wood. C. C. Orford.
Lepeta cæca, Müller. R. C. Walton.
* *Actæon? Etheridgii*, Bell (n. sp.). Shell elongated, scalariform or turreted, thin, smooth, apex reversed; whorls 5–6; inner lip with one strong fold on the base of the columellar lip. Long. $\frac{3}{10}$ inch. R. C. Walton. Of this elegant little shell I have obtained but two specimens.
Rhynchonella psittacea, Chemn. R. C. Sutton.
* *Ostrea cristata*, Born. C. C. Sutton.
*—— *cochlear*, Poli. C. C. (Jeffreys). R. C. Waldringfield.
Anomia patelliformis, Linné. Chil. ser. Sudbourn, near Orford.
Pecten princeps, Sow. R. C. Waldringfield. Chil. ser. Yarn Hill.
*—— *Westendorpianus*, Nyst. R. C. Waldringfield.
Hinnites giganteus, Carpenter, = *H. Cortesyii* (Crag Moll.). R. C. Trimley.
Limopsis pygmæa, Philippi. R. C. Walton.
Nucula nucleus, Linné. R. C. Butley.
Leda pygmæa, Münster. R. C. Walton.

Leda hyperborea, Lovén. R. C. Butley.
Cardium angustatum, Sow. N. C. Thorpe, Suffolk.
—— *interruptum*, Wood. C. C. Orford.
—— *strigilliferum*, Wood, = *C. elegantulum*, Möller. *Hab.* North seas.
* *Cardita borealis*, Conrad, = *C. analis*, Phil. Chil. ser. Sudbourn, near Orford.
—— *rudista*, Lamarck, = the long variety of *C. senilis* (Crag Moll.), the shorter being the *Arca antiquata* of Poli, but not of Linné, and the *C. sulcata* of Lamarck.
Erycinella ovalis, Conrad. R. C. Walton.
Venus ovata, Pennant. R. C. Butley.
—— *chione*, Linné. R. C. Waldringfield.
* *Tapes pullastra*, W. Wood. R. C. Waldringfield.
—— *virginea*, var. *sarniensis*. C. C. Orford. = *T. perovalis*, Wood?
Gastrana laminosa, Sow., = *Petricola ventricosa*, Krauss. *Hab.* South Africa.
* *Neæra arctica*, Sars. C. C. Orford.
* *Pholas dactylus*, Linné. R. C. Walton.
* —— *parva*, Pennant. R. C. Waldringfield.
* *Toxopneustes dröbachiensis*, Müller. R. C. Butley.
Echinocyamus oviformis, E. F. R. C. Walton.
—— *hispidulus*, E. F. R. C. Walton.
Flabellum Woodii, Milne-Edwards. R. C. Waldringfield.

In pursuance of a statement made by myself at the Norwich meeting of the British Association concerning the *non-derivative* character of the fossils of the Red Crag (except in such palpable instances as those of Eocene shells, &c.: see Report of Sections), I have now by me a list of nearly fifty species of bivalves which I have seen with the *valves united*, from this deposit, including *Solen ensis*, *Panopea Faujasii*, *Mactra glauca*, and many species which are held together by very slight ligamental fastenings.

XX.—*On two new Siliceous Sponges taken in the late Dredging-Expedition of the Yacht 'Norna' off the Coasts of Spain and Portugal.* By W. Saville Kent, F.Z.S., F.R.M.S., of the Geological Department, British Museum.

[Plate XV.]

In addition to the form described as *Pheronema Grayi* in last month's number of this Magazine, other sponges were taken at a considerable depth, which, though not so pretentious in

size, in point of structure are deserving of an equal and perhaps even a greater amount of attention.

The first of these which I shall proceed to describe would seem, in the present transitional condition of the classification of the Porifera, to find its most natural position among that group of the Silicea known as the order ARMATOSPONGIÆ of Dr. J. E. Gray, and of which the genera *Tethya*, *Microciona*, and *Esperia* are familiar representatives.

All the examples of this form taken were, without exception, attached to specimens of the compound Madrepore *Lophohelia prolifera* or its variety *anthophyllites**. The external aspect, natural size, of a specimen attached to the coral is indicated at Pl. XV. fig. 1; fig. 2 being a transverse section of another specimen magnified about two diameters, while fig. 3 represents a small fragment with two dividing fascicles of spicula which form the upright supporting pillars to the "pincushion-like" cortex. The spicula, entirely siliceous, which enter into the skeletal structure of this sponge may be referred to three distinct types.

1. Simple acerate spicula of two sizes.
   a. Very minute and attenuate, not exceeding $\frac{1}{300}$ inch in length. Pl. XV. figs. 4 & 4 *a*.
   b. Of the same type, but comparatively blunt-pointed, averaging a length of $\frac{1}{25}$ inch. Pl. XV. fig. 5.
2. Pin-shaped or "spinulate" spicula; heads or bases usually pyriform, sometimes slightly depressed; average length $\frac{1}{25}$ inch. Pl. XV. figs. 6 *a*, *b*.
3. A minute form, most closely approaching the "palmated inequianchorate" type (Bowerbank, Brit. Spong. pl. 6. fig. 138, spicule of an undescribed sponge); varying in length from $\frac{1}{1000}$ to $\frac{1}{250}$ inch. Pl. XV. fig. 7.

The essential characters of the sponge-body, and the relationship of these various types of spicula to the same, are as follows:—

In the first place, we have a thin basal layer of sarcode covering the object to which the sponge is attached, and in which are distributed fascicles of the minuter acerate spicules, with a few isolated larger ones of the same type interspersed. From this layer there proceed at right angles upright shafts or pillars composed entirely of these larger acerate spicula, attenuate at their base, but expanding and evincing a ten-

* I entirely agree with Dr. P. M. Duncan that these two forms are simply variations of the same species.

dency to divide superiorly, where they become lost in the layer which composes the roof of the vaulted cavity enclosed beneath. This roofing layer of sarcode, slightly denser than the basal investing one, contains spicula of the same type, the fascicles of the minuter variety being particularly abundant. Exterior to this we meet with the spicula which confer upon the sponge its most characteristic external feature. These belong to the "spinulate" type, and are the largest which enter into the composition of the skeleton; they are all so disposed that their knobbed termination or head is directed outwards, while the opposite attenuate extremity passes through the superior layer of sarcode into the fascicles of large acerate spicula forming the upright supporting pillars. A few of these last acerate spicula are also occasionally met with projecting among the spinulate ones. The third and last type of spicula, "palmato-inequianchorate," occur, but not abundantly, in the sarcode investing the supporting pillars; and with these may also occasionally be found a few stray fascicles of the smaller acerate form.

No especial oscular system appears to belong to this sponge, and it would seem probable that all matters of nutrition are received through temporary apertures occurring in the thin cortical layer of the sarcode, rejectamenta being got rid of through the same channels.

Rhaphidotheca Marshall-Hallii are the generic and specific names by which I propose to distinguish the sponge just described,—the first in reference to the external aspect this form presents under a low power of the microscope, it being so suggestive of a well-stocked pincushion that it was impossible to resist the temptation of giving a name which should bear some reference to this resemblance; and the one chosen supplies the desideratum. The specific one, I need scarcely mention, is a slight acknowledgment of my indebtedness to my friend Mr. Marshall-Hall, who so liberally devoted his yacht and time to the furtherance of this expedition, for the recent delightful cruise combined with opportunities of indulging a keen appetite for the acquirement of practical zoological information unattainable through any other source.

The second sponge I have to notice is, like the first, found associated with a coral, the single specimen obtained being attached to a mass of *Lophohelia prolifera*, var. *anthophyllites*. In common with *Rhaphidotheca*, this form is also provided with a distinct cortical skeleton; but the nature of this skeleton throughout makes it necessary to refer it to the

order CORALLIOSPONGIÆ of J. E. Gray*. Unfortunately the unique specimen taken was devoid of the sarcode which invested it in life, and in a fragmentary condition on its arrival on board our yacht. Sufficient, however, was remaining to illustrate the peculiarities of the form and its distinctness from any other member of the group previously described. One of the most striking superficial characters of this sponge lies in the presence of numerous spherical bodies, varying in size from the diameter of about $\frac{1}{30}$ to $\frac{1}{15}$ of an inch, contained within its general interior cavity; these are invested with, and have radiating from their external surfaces, an irregular meshwork of comparatively coarse siliceous fibres, which pierce through the delicate inner layers and coalesce with the external reticulation of the cortex to be presently described. The structure of these large coarser fibres is such as to warrant their being described as for the most part entirely, minutely, and erectly spined; interspersed among and attached to them are numerous minute "rectangulated hexradiate" spicula (Pl. XV. fig. 9 *a*); these are also spined in a like manner. The specimen taken (about one half of a perfect individual) contained as many as nine or ten of the spherical bodies alluded to; and its general outward appearance, with some of the contained spherules, is represented in Pl. XV. fig. 8. Fig. 9 is one of these bodies isolated, with the investing and radiating fibres considerably enlarged; and at fig. 10 is an example less magnified, showing its relation to the cortical layer beneath. At first the possibility of these bodies being of the nature of gemmules most strongly suggested itself; but a clean section of one (Pl. XV. fig. 11) at once proved that they were simply close aggregations of spicula forming a dense and not altogether irregular network, comparable to the reticulated pith of many plants, such as that of *Juncus*, viewed under similar conditions. Fig. 12 is a minute frag-

* I must here venture to affirm that this order, the CORALLIOSPONGIÆ of Dr. Gray, embodies all the characters of a most natural one, and must necessarily take precedence of that of the VITREA, subsequently proposed by Prof. Wyville Thomson. It includes all these sponges of which the essential skeleton is composed of coalescent or reticulated siliceous fibres or spicula instead of free or isolated ones. To this first character it seems probable that that of the fundamental "hexradiate" type of the component spicula, proposed by Wyv. Thomson, should be also added, though further confirmatory evidence is wanting in many instances.

When penning my notes on *Pheronema* for the last Number of the 'Annals,' I did not recognize so fully as I do now the the comprehensiveness of Dr. Gray's order, otherwise the genus would have been arranged under that instead of the Vitrea.

ment of the interior of one of these bodies, detached and still further magnified; but it furnishes nothing more towards the interpretation of their true significance*. The next part demanding attention is the cortex, the appearance of which in longitudinal section is illustrated in fig. 13, consisting exteriorly of an irregular and somewhat coarse network of spicula, but having on its interior surface even reticulated laminæ of extreme tenuity; these latter are strengthened by rather stouter spicula traversing them at intervals, for the most part at right angles, and which by frequently giving off at the point of crossing superior and inferior shafts, form connecting media with the circumjacent reticulations, major and minor, in addition to demonstrating their hexradiate type of structure—a type, by the way, which is still more clearly exemplified in the fibres investing and radiating from the spherules, though mostly so in the minute ones attached to them. In the delicate reticulated laminæ just referred to, the component meshes are perfectly flattened, and not cylindrical, as is the case with the other reticulated portions of the organism—a phenomenon, I think, occurring in no hitherto described sponge. The superficial appearance of these laminæ is represented in figs. 14 & 15, and in the groundwork of fig. 10.

The dead and partly crushed condition of this sponge, and the consequent absence of the sarcode, unfortunately prevent me from making any observations on the minute free spicula which we may reasonably anticipate were immersed within it. Scientific investigators at present engaged in conducting dredging-operations in waters contiguous to those from which this specimen was obtained may, however, shortly be in a position to fill in the missing link. As with the first sponge described in this paper, no special oscular or porous system is recognizable, though the general reticulated structure of the cortex would readily admit of the free access of all matters of nutrition.

It being necessary to create a new genus for the reception of this form also, I propose to distinguish it by the name of *Fieldingia*, in honour of my *compagnon de voyage*, Mr. Edw. Fielding (to whose skilful pencil we are especially indebted for numerous telling sketches of the lovely scenery through which we passed), adding the specific one of *lagettoides*, after the lace-bark tree, in reference to the delicate reticulated laminæ associated with the cortex, which are so strongly

* My friend Prof. Perceval Wright, to whom I have had the opportunity of exhibiting specimens of these curious bodies, was struck with their resemblance to the "xanthidia" found in flint—a suggestion I hope at some future time to follow up.

suggestive of the internal lace-like layers of the bark of the tree in question. The following will serve as a brief technical *résumé* of the two new genera and species here introduced; each of these latter standing at present as the sole representative of its genus, the characters embodying the genus will also be inclusive of the species.

Subclass *PORIFERA SILICEA*, J. E. Gray.

Order ARMATOSPONGIÆ, *ib.*

Fam. **Esperiadæ**, *ib.*

Gen. nov. RHAPHIDOTHECA.

Sponge incrusting, cavernous interiorly; entire external surface of cortex bristling with spinulate spicula having their attenuate apices directed inwards and mingling freely with the fascicles of simple acerate spicula which form upright supporting pillars to the roof; fascicles of smaller acerate spicula abundant in the sarcode of the cortex, and also distributed less frequently in the basal layer of sarcode, and in that investing the shafts or pillars; in the latter, also, minute spicula of the "palmato-inequianchorate" type (Bowbk.). Oscula absent or indefinite.

R. Marshall-Hallii, ib. Pl. XV. figs. 1–7.

Hab. A depth of 500 fathoms ten miles off the shore of Cezimbra, Portugal; attached to *Lophohelia prolifera.*

Order CORALLIOSPONGIÆ, J. E. Gray.

Gen. nov. FIELDINGIA.

Sponge adherent, consisting of a cortex of irregular reticulated spicula, having on its interior surface numerous reticulated laminæ of extremely delicate consistence. Common cavity of the sponge containing numerous spherical aggregations of spicular reticulations; these invested and brought into relation with the cortex by loose reticulated fibres of coarser structure, having a general hexradiate arrangement; these fibres cylindrical, and to a considerable extent minutely and erectly spined; frequently attached to them very diminutive spicula of the "rectangulated hexradiate" type, these also minutely and erectly spined. Nutritive and exhalant functions most probably performed through the general reticulations of the cortex.

F. lagettoides, ib. Pl. XV. figs. 8–15.

Habitat and associations similar to the last.

Affinities of the described Species.

Rhaphidotheca Marshall-Hallii, on account of its possession of simple acerate, spinulate, and bianchorate spicula, and the non-existence of pronged, uncinate, or stellate forms (characteristic of the Tethyadæ), falls naturally into the family Esperiadæ of the Armatospongiæ of Dr. Gray. The characters of the spicules alone suggest its close affinity to the genus *Esperia* (O. Schmidt) itself; but the general contour of the sponge-body, and the relationship of the respective forms of spicula to the same, forbid its being embodied in it. The only illustration of an approach to the peculiar vaulted character of the interior cavity of this sponge is exemplified in a portion of the form figured and described as *Ciocalypta penicillus* by Dr. Bowerbank in his 'British Spongiadæ;' the other characters of that sponge, however, are totally different. *Tethya spinularia* (Bowbk.) would also seem to show certain affinities, and especially in the presence of fasciculi of small acerate spicula, and in the possession of spinulate forms; but this last spinulate type, instead of being confined to the cortex, are distributed through the various regions of the sponge: this and their peculiar form ("ovo-spinulate," Bowbk.) would suffice to demonstrate the specific difference between Dr. Bowerbank's species and my own; while the massive character of the sponge-body of the former, and its well-developed oscular system, further demand its generic separation. I would, moreover, venture to suggest that the time has now arrived for the separation of *T. spinularia* from the Tethyadæ proper, the characters of its spicula denoting the necessity of referring it to the Esperiadæ, and also in all probability to the type genus of that family.

Regarding the new genus *Fieldingia*, in the present limited state of our knowledge of the Coralliospongiæ, it seems difficult to establish any immediate bonds of affinity. *Thionella* (Dr. J. E. Gray, Proc. Zool. Soc. 1868), however, in the more massive character of its cortical layer, and in its internal reticulated structure, indicates a distant resemblance, yet closer than is to be found in either *Habrodictyon*, *Hyalonema*, *Euplectella*, *Aphrocallistes*, *Dactylocalyx*, *Farrea*, *Macandrewia*, or *Pheronema* (*Holtenia*, Wyv. Thomson), the remaining genera of the order with which we are at present conversant.

EXPLANATION OF PLATE XV.

Fig. 1. *Rhaphidotheca Marshall-Hallii,* nat. size, adherent to a piece of *Lophohelia prolifera.*

Fig. 2. A section of the same, showing the vaulted internal structure,

magnified 2 diameters. The dark line *c* indicates the boundary of the coral.

Fig. 3. Two of the upright supporting pillars, with a portion of the cortical layer or roof, showing the relationship of the pin-head or "spinulate" spicule, × 25 linear.

Fig. 4. A group of the small acerate spicula which occur principally in the cortical and basal investing layers of the sarcode, × 100 linear. 4 *a*, a few × 250 linear.

Fig. 5. One of the larger acerate spicula which enter into the construction of the upright supporting pillars, × 50 linear.

Fig. 6. Spinulate spicula of the cortex: *a*, the ordinary form; *b*, upper portion of one with head somewhat depressed, × 60 linear.

Fig. 7. "Palmato-inequianchorate" spicula of the sarcode, × 250 linear. The top figure is an example in profile.

Fig. 8. *Fieldingia lagettoides*, in section, nat. size, showing the spherical bodies with their radiating fibres contained within.

Fig. 9. One of these bodies isolated, with the investing and radiating fibres × 15 linear: at *a* and at various other parts the minute "rectangulated hexradiate" spicules are depicted.

Fig. 10. A smaller one attached to the inner layer of the cortex. The upper part of the figure illustrates the finer reticulated laminæ of the cortex, while below is shown a looser reticulation which usually intervenes between the former and the coarser network of the internal cavity, × 10 linear.

Fig. 11. A transverse section of a small spherule, illustrating the internal reticulated structure, × 40 linear.

Fig. 12. An isolated fragment of this internal reticulation, × 100 linear.

Fig. 13. The general cortex in transverse section, × 10 linear.

Figs. 14 & 15. Fragments of the inner reticulated laminæ, × 50 linear.

XXI.—*Description of a new Species of* Seïsura. By John Gould, F.R.S.

Seïsura nana, Gould.

Head glossy greenish black; back and tail the same, but somewhat lighter; wings brownish black, the secondaries with paler edges; under surface white, tinged with buff on the chest; bill and legs bluish lead-colour.

Total length 6 inches; bill $\frac{3}{4}$, wing $3\frac{3}{4}$, tail 3, tarsi $\frac{3}{4}$.

Habitat. Northern Australia.

Remark. In form and colouring this species is very similar to *Seïsura volitans*; but it is so much smaller as to preclude the possibility of its being identical with that bird. It was received from Mr. Waterhouse of Adelaide, South Australia, accompanied by a *Limosa uropygialis* in the red or summer plumage, and some other species common to the northern part of the country.

XXII.—*On some new Fundamental Principles in the Morphology and Classification of* Rhynchota. By Professor J. C. Schiödte*.

I.

In all the large independent works, as well as in the numerous minor treatises, by which Latreille has founded the natural system of the articulated animals, there is an undercurrent of merely indicated scientific views, which he has abstained from working out, either because time and material failed him, or because he lacked the necessary courage and confidence in his own ability to get over some mistake of observation, often an entirely accidental one, which had stopped his progress. Thus, for instance, his exceedingly ingenious theory of the "segment médiaire," which, rightly understood, solves so many hard morphological knots, and is of such comprehensive and useful application in classification, has had the fate of being rejected by such anatomists as Burmeister, Westwood, Straus-Dürckheim, Lepelletier de St. Fargeau, Newport, Spinola, and Lacordaire, only because he was unable to supply that conclusive element which was required to give it scientific certainty and support it by decisive proof—namely, the demonstration of the apparently missing pair of spiracles between the second and third thoracic rings in *Piezata* †. There are other cases where Latreille has incidentally pointed out the importance of certain features in the structure of insects which are more easily investigated, and where these indications, which the great French naturalist had left undeveloped, have been investigated by subsequent authors; but they have rarely done more than accumulate descriptive details. As an example we may adduce a passage in 'Le Règne Animal' (nouv. éd. 1829, tom. iv. p. 306), where, after having treated of the relation between the epimera and the segments of the body, he continues in this manner:—"Les relations de ces parties, la grandeur et la forme du premier article des hanches, la manière dont elles s'articulent avec le demi-anneau dont elles dépendent, l'étendue et la direction de ce demi-anneau variant, le thorax considéré sous ce point de vue, présente une combinaison de caractères, qui est très avantageuse pour la méthode." The indication of the differences in the mode of articulation of the limbs with the body which is contained in these words was never more fully

* Translated from 'Naturhistorisk Tidsskrift,' ser. 3, vol. vi. 1869. Copenhagen.

† See 'Proceedings of the Royal Danish Society of Sciences, 1856, p. 135.

developed by Latreille. Later zootomists and systematic authors, particularly Spinola and Erichson, have certainly occasionally turned their attention to the coxæ of Eleutherata, and distinguished between coxæ globosæ, transversæ, and conicæ. But these distinctions, which only take into consideration the external form, are in themselves superficial, and lack the desirable sharpness and certainty of application, even when considered from the merely descriptive and diagnostic point of view—because coxæ globosæ, by a gradual elongation downward, insensibly become coxæ conicæ, and by lateral extension at last coincide with coxæ transversæ, whilst the latter, when inclined inwards and downwards, become undistinguishable from coxæ conicæ. Besides, coxæ of each of these forms may be more or less moveable, and there is an insensible transition between those which are deeply inserted into sockets of articulation and those which are more superficially fixed; in consequence of which the distinction which now and then is made between coxæ fixæ and coxæ mobiles, not only does not state any thing about the mode of movement, but is without connexion with the distinctions made with regard to form. These distinctions, therefore, however useful they may be within a limited systematic division, do not touch the central point of the question, which I hope to be able to place in a clear light by the following considerations.

The limbs of Articulata articulate with the body in two principal ways, corresponding to two fundamental forms of coxæ—*coxæ cardinatæ* and *coxæ rotatoriæ*.

*Coxæ cardinatæ** are either immoveably connected with the body, or they can only be moved slightly from side to side, or backwards, in the direction of the longitudinal axis of the animal. The mobility being reduced, the epimera and the sternum, which are intended to contain the muscles serving for the movement of the coxæ, are correspondingly reduced in size, whilst the coxa itself, which in this case alone has to accommodate the muscles which move the remainder of the leg, becomes more expanded and capacious in the same proportion. Where powerful movements are executed in a horizontal plane, by which the leg at the same time describes a large arc, particularly in running or swimming, the large coxa is furnished with a groove (scrobiculus femoralis) on its external surface, in order to obtain space for the bending forward of the leg.

Coxæ rotatoriæ can be turned round their own longitudinal

* This expression is borrowed from Vitruvius (in the paper "De aliis testudinibus," Schneider's edition, i. 301).

axis. In this case the muscles which move the coxæ always demand more space, and in the same proportion the epimera and the sternum are increased in size. The coxa itself being rendered more independent of the neighbouring parts by its greater mobility, may and does vary considerably in size, but retains always a rounded shape, and is always fitted in a deeper socket. In legs serving the purpose of walking, the rotatory coxa is frequently very small and reduced to a mere node of articulation for the remainder of the leg, whilst its size is often very considerable where the legs are used for running or swimming, and still more in fossorial legs. In the former case the coxæ will be separated by a considerable interval, and placed so near the sides of the animal that the movement of the leg becomes sufficiently clear of the body; and no groove will then be necessary for facilitating the bending forward of the leg. But in the latter case the coxæ must meet in the middle, as the large cursory and natatory forms of coxæ cardinatæ; and a groove will then be necessary also in the case of coxæ rotatoriæ. Typically, however, this combination is as much calculated for walking as that of the coxæ cardinatæ is calculated for running, springing, and swimming.

Both forms of coxa may occur in the same animal, particularly in this way—that only the foremost or some of the foremost pairs of limbs have rotatory coxæ. When those limbs which serve for the progression of the animal have cardinate coxæ, the animals may be described as *Pagiopoda*; but when the progression of the body depends on limbs with rotatory coxæ, we may describe them as *Trochalopoda*.

The great majority of Articulata of all three classes are *Pagiopoda* in a great variety of modifications, in many cases affording excellent characters for natural divisions, which have not yet been made use of, but which cannot be further explained in the present treatise. A considerable number of Eleutherata and Rhynchota are *Trochalopoda*; and it is with regard to the latter of these orders that the whole subject has been mooted here, because, when combined with certain other elements of structure which have likewise hitherto been overlooked or not rightly interpreted, they may serve for a more natural classification than that which has hitherto been adopted.

II.

The classification of Rhynchota stands in scientific respects still at the same point at which it was left by its founders, Fabricius and Latreille; it is scarcely possible to point out any new or fruitful idea which has been applied to it since.

At the same time, this order has, during the last two or three decennia, been worked up with predilection by a number of specialists, to whose untiring and in part very meritorious exertions we are indebted for an astonishing increase in the number of described species. The isolated merely descriptive treatment of the contents of the different museums, however, has had its usual consequences: the classification has become a mere register of specific characters; the distinction between its categories has been rendered evanescent; and it has ceased to reflect the typical unity of the morphological variations. So far from the true understanding of the structure and life of the animal having been furthered, the state of our knowledge, on the contrary, as may be seen by consulting the newest and most used manuals, has receded several steps behind the standpoint to which the leading works of thirty years ago had brought it. In the following, however, we shall confine our investigation of the present classification to those cardinal points which come into consideration in establishing the scheme which we propose.

The very first point in the morphology of Rhynchota, which is of primary systematic importance, is erroneously stated by all the authors that I am acquainted with.

The two natural suborders Homoptera and Hemiptera are in their whole habitus so distinct that even the most superficial investigation cannot fail to appreciate their difference; and the perception of these two suborders can be traced in the writings even of the very earliest naturalists. But it was found that a suitable diagnosis of their difference could not be obtained by means of the changeable forms of the wings; and it was then proposed to distinguish them by means of the place of insertion of the rostrum, which was supposed to be fundamentally different in the two orders, of which accordingly one, the Heteroptera, often were described as *Frontirostria*, whilst Homoptera were described as *Gulærostria*. In the former case the rostrum was supposed to take its origin from the epistoma, in the second case from the underside of the head—hypostoma. This view is undoubtedly at variance alike with common sense and the first elements of a scientific appreciation of the structure of the head in Articulata. It is true that it has been adopted by men of scientific spirit and knowledge, like Latreille, Dufour, Burmeister, and others, who cannot possibly have been ignorant of the fact that the parts of the mouth in all cases have their basis on morphologically the *same* parts of the head, whatever position these parts may occupy in the general outline of the animal, according to the exigencies of its structural combinations. But these zoolo-

gists evidently thought that they might content themselves with treating the matter from the point of view of simple horismology, and that, at any rate, the distinction practically worked so well that a morphologically true character might be dispensed with, just as ichthyologists are content to say that the mouth in Sturgeons and Plagiostomata is placed on the under surface of the head. But the fact is that the definition does not hold good even if it is understood in a purely horismological sense—that is, even if the parts are named without regard to their morphological value. Between the structure of the *Reduvii*, where the rostrum appears as an immediate continuation of the top of the head, and that of *Cicadæ*, where it closely adjoins the prosternum, there is a series of insensible transitions, represented by the swimming species, as well as by many living on the land, such as the *Platycephala*; and the whole question about the so-called position of the rostrum resolves itself into this, that the forehead is more or less bent in under the head. The distinction hitherto supposed to be expressed in the position of the rostrum is as untenable as that derived from the wings; and the diagnoses of the two suborders have become so loose and indefinite, and, by additional explanations and restrictions so prolix, that, in the new manual of Fieber on the European Rhynchota-fauna (a volume in large octavo), they fill respectively nine and sixteen closely printed lines in small type. There is evidently here a serious defect in our knowledge. Unless a clear and well-defined mark of distinction between the two suborders can be found which is connected with their mode of life and expresses a morphological difference, it is far better to unite them: the present uncertain and tentative mode cannot satisfy any body.

It is evident that the rostrum must correspond to the food. But the sharply defined varieties of form and the manifold combinations of division of labour which solid food, by its varying degree of resistance to prehension, division, and deglutition, necessitates in the appendages of the mouth are, as a matter of course, only to a small extent observable in Rhynchota, which only live upon organic juices, animal or vegetable. The rostrum naturally varies to some extent in strength, length, curvature, stiffness, &c., according to the nature of the surface which has to be perforated before the nutritious liquid is reached; but we cannot expect to find any sharp lines of demarcation between these different forms, because when the animal has got hold of the body to be perforated, the work to be performed by the pungent instrument will always be essentially the same. But it is quite different with those organs which are to enable the animal to find the suitable surface,

reach it, and get it in its power. Whether the animal runs about hunting living game, and keeps it by force whilst sucking out its blood, or slinks from place to place as a parasite on the skin of another animal, or remains immovable for days and weeks on the same part of a plant, in lazy sociability, and fills itself with the juice, these are differences in the mode of life which must be accompanied by corresponding differences in the organs of sense and movement; and we find accordingly that Rhynchota vary in this respect to a very great extent, whilst they exhibit a striking uniformity in the structure of their mouth. Similar conditions of life occur in Antliata. But whilst in Antliata the structure of the imago, on account of the complete metamorphosis, is more exclusively calculated to serve the propagation of the species, the structure of the adult animal in Rhynchota is equally determined by the exigencies of the propagation of the species and the nutrition of the imago itself. Hence arises the overwhelming, teeming multitude of different forms, in which Rhynchota surpass all other orders of insects, and which renders the interpretation of their morphology and their classification a task of so great difficulty and intricacy that entomologists have preferred to evade it instead of attempting a solution of it, and carried the subdivision so far that their efforts at recognizing the types of these animals have ended in the suicidal result of considering very nearly each species to represent a generic type by itself. But although, as we have just explained, such variation in the structure of the mouth as we meet with in animals which catch and masticate their food by means of the appendages of the mouth cannot be expected in sucking animals like the Rhynchota, it cannot, on the other hand, be supposed that the great difference which upon the whole must exist between animals which exclusively live on vegetable juice, such as exclusively feed on animal juices, and those, finally, which partake of both kinds of nourishment, would not, in the midst of all this richness in form, be marked by some decisive and distinctive anatomical feature. More particularly we may confidently assert that the quiet expanded surface of the plant demands quite other properties in the structure of the Rhynchoteous animal than the sharply defined, plastic, rounded body of the living animal writhing and turning about under the attack of the blood-sucker. In both cases strength in directing the thrust of the rostrum is required, particularly in the former case; but there is one provision required by the blood-sucker, which would be most injurious to the sucker of vegetable juices; and that is, facility in changing the aim of the rostrum during use, particularly as many blood-suckers

first kill and then suck, and consequently must often repeat the thrust. In this latter case the whole figure must be slimmer, the head smaller and susceptible of lateral and rotatory movements, whilst the shape of the head and rostrum for the rest may vary very considerably according to the nature of the prey. But in the former case the general figure of the animal will naturally be shorter, more thick-set; the head, more particularly, will be larger, because it is to accommodate the more powerful muscles required for penetrating the firmer vegetable surface; while at the same time there is no need of the head being capable of turning to the side or round its longitudinal axis, nor is there any occasion for considerable variations in the form of the head or the rostrum, as these animals can always assume essentially the same position in the act of perforation and suction.

The blood-suckers, moreover, require principally fitness for running and walking, whilst those which live on vegetable juices want adaptation for springing and flying. On closer examination, this circumstance will supply us with the true key to that difference in habitus between Heteroptera and Homoptera which has been dimly recognized almost from the beginning, but which entomologists have not yet been able to express satisfactorily in their diagnoses, though in practice they have rarely erred in referring any particular species to one or the other of these suborders. The reason why the difference in question has not yet found a satisfactory expression in systematic diagnoses, is this—that in proportion as the Heteropterous type is accommodated for subsistence on vegetable juices, it is as it were veiled by an imitation of the Homopterous cicadarian type. The main point is, that in the phytophagous type of Rhynchota the head is so modified in shape as to enable it to receive support from the prothorax; for the thrust of the rostrum cannot be executed with collective force if it is directed out from the body of the animal; the requisite force is obtained only when the thrust is directed inwards, supported by the weight of the animal and its firm footing on the surface in question. Therefore the rostrum is always directed backwards; and when the animal is to become exclusively phytophagous, special arrangements become necessary in order to render this direction the only one possible, so that the whole power may be concentrated in this direction only.

The broad and flat form of the head of the *Cicada*, which is *not* capable of turning, is *imitated* by the head of bugs, which are not exclusively blood-suckers, although their head is always capable of turning. The imitation consists in this, that the

head, without augmentation of its inner capacity, is increased in size by expansion of its margins—a plan which entails similar expansions of the prothorax and, at least in part, of the following body-segments. In such bugs as, for instance, *Cimices* and *Corei*, including *Tingides* and *Aradi*, head, thorax, and abdomen may have the appearance of considerable size, and a shape reminding one of the *Cicadæ*, whilst, in reality, with regard to space for the soft parts of the body, they are not larger than the slimmest *Reduvii*. But in spite of the expansion of the margins, the lateral and rotatory movements of the head, which are conditions of carnivorous habits, are not much curtailed, because the neck retains its shape. In Homoptera this is different: the head is really as large (that is, as capacious) as it appears outside. Here, then, we have got at a fundamental difference, which may be obscured to the more superficial consideration, but which in its nature must be thoroughgoing, and which in reality expresses itself with all desirable sharpness in a certain feature of external structure. In order to cause the two contrary movements, viz. the pressing backwards of the head and the rostrum and the pressing forwards of the body, to cooperate under the most favourable conditions by the diminution of the distance between their starting-points, the forehead is bent so far in under the animal that a struggle for space, so to say, arises between the head and the fore legs, which only can be solved by a compromise, namely thereby, that the coxæ of the fore legs to a certain extent are accommodated in the head, in excavations of the cheeks, which consequently, though it sounds absurd, really take part in the formation of the articular socket of the first pair of coxæ. By this arrangement it becomes, of course, impossible for Homoptera to turn their head during perforation or suction; they are unable to do more than to raise or depress it a little. In Heteroptera no such thing takes place, however broad and flat their head may appear: the cheeks only reach to the prosternum, but never so far as the front legs, and the head therefore retains its capability of turning on the protracted cervical process. These facts, then, lead to the following diagnosis of the two suborders:—

Homoptera. First pair of coxæ articulate with the cheeks.
Heteroptera. Cheeks and first pair of coxæ do not touch each other.

III.

All Homoptera are Pagiopoda and phytophagous; they exhibit a great variety of forms, which, however, all range

themselves into one series, proceeding without lateral branches from *Cocci* to the true *Cicadæ*, in one and the same direction, the lowest stage being characterized by sedentary habits (with propagation during summer without previous development of sexes), the higher ones by different degrees of freedom of movement—particularly springing and flight, and various combinations of these two modes of movement, which necessitate special developments of head and thorax as instruments of balance, causing the fantastic appearance of many Fulgoridæ and Membracidæ.

Amongst Heteroptera, on the other hand, some are exclusively blood-suckers; others subsist both on vegetable and on animal juices; and they exceed therefore the Homoptera in variety of form. Some are Trochalopoda, others Pagiopoda.

The coxæ of trochalopodous Heteroptera are round and, at least on the outer side, embraced by a projecting margin of the metathorax, which corresponds to their outline, whereby a proper socket is formed. These Trochalopoda comprise two great divisions—those which feed on mixed food, and the pure carnivora.

A. *Trochalopodous Heteroptera living on mixed food.*—The tendency to expansion and thick-set structure which we have explained above as characteristic of phytophagous habits, shows itself here, even in the slenderest species, also in the metathorax, which has the appearance of a plate, of which the posterior margin forms a projection of varying extent, beyond the first abdominal segment. By degrees, as carnivorous habits prevail, the lateral edges of the body are less expanded, and we observe a gradual transition from the short angular bug-type with elliptic transverse section to the elongated oval shape with even lateral margins and increasing depth of body. This series of bugs has been broken up by systematic authors into a number of small families, mostly based on general habitus, but in part also based on the number of joints in the feet and in the rostrum. But the number of tarsal joints may be different in species otherwise nearly allied, and the tube of the rostrum is in reality four-jointed in all Rhynchota; when they are sometimes said to have a rostrum of a less number of joints, this really only means that the basal joints are small, partly hidden by the projecting parts of the forehead, and not counted. I consider it far more natural to determine the steps of this series by the position of the antennæ, which depends on the different degree and the direction of the expansion of the head—that is, by the marks pointed out by Fabricius and Latreille,—the antennæ being either inserted

under the margin of the forehead or free at their insertion, and in the latter case inserted either at the top of the head, in the same line as the eyes, or below the eyes on the sides of the head. Thus we arrive at three large families—*Cimices* (with *Tetyræ* and the fossorial group of *Cydnini*), *Corei* (with *Aradi* and *Tingidæ*), and *Lygæi*. It is only within the latter family that predatory habits so far predominate that the first pair of limbs are sometimes developed into instruments for catching the prey.

B. *Purely carnivorous trochalopodous Heteroptera*.—The whole structure is calculated for freer movements; the projecting margin of the metathorax is wanting, and the root of the abdomen is entirely *uncovered*. The first pair of legs are generally adapted for catching the prey. This series of bugs, too, has been divided into a number of small families, and they have in part been mixed with those of the preceding series and with Pagiopoda. This group may naturally be divided in a manner corresponding with the local circumstances of life. *Reduvii* (with *Syrtis* and *Nabis*), which live on dry land, have terminal claws; *Hydrometræ*, which run on the surface of water, have the claws inserted above the point of the foot, and are, at least on the ventral surface, clothed with an aëriferous felt. Both families consist of animals living in atmospheric air, and have free antennæ and spiracles. Those of the third family, *Nepæ*, climb or row under water, and have short antennæ hidden under the cheeks; their spiracles are by special contrivances secured against the entrance of the water; and the last pair is transformed into a long respiratory tube.

The triangular posterior coxæ of the pagiopodous Heteroptera join the metathorax with the whole of their open base, and occupy its posterior margin; they reach, consequently, as far out to the sides as the metathorax, but a part of their real extent is sometimes hidden by the margin of the metathorax forming a flat projection which covers their external part, without, however, embracing the coxa as in Trochalopoda. The Pagiopoda are all blood-suckers. From the morphological point of view, these, therefore, repeat the series of forms observed in Trochalopoda—but with this difference, that the basis of the abdomen is naked. Recent authors, not being aware of the important character which binds them together, have split them into a great number of small families, and mixed them up with Trochalopoda. According to the localities in which they live, they are divided into:—*Acanthiæ* (*Capsus* and *Miris*, *Anthocoris*, &c., and *Xylocoris*, *Salda*, *Leptopus*), with free antennæ; *Pelegoni*, living on shores, with hidden

antennæ and cursorial limbs; and swimming-bugs, with hidden antennæ and swimming-legs. The latter are again divisible into those which swim on their back (*Notonectæ*), boat-shaped, and with free rostrum, and those which swim in the usual position, which again are divisible into *Naucorides*, with free rostrum and free metathorax, *Belostomata*, with free rostrum and the sides of the metathorax covered by the overreaching lateral parts of the mesothorax, and *Corixæ*, with hidden rostrum and free metathorax. The family of *Acanthiæ* comprises species indicating, so to say, the developments of the type into the other families: *Pelegoni* more particularly are indicated by *Salda*. For the rest, it is still doubtful whether *Pelegoni* and *Naucorides* can be sharply distinguished from each other.

In trochalopodous as well as in pagiopodous Heteroptera, the articulation of the abdominal segments is in the same degree more moveable as the structure is more exclusively calculated for carnivorous habits, particularly when the animal lives under circumstances which in themselves require greater flexibility of the body, for instance, in the water, or hunting on plants; but if it seeks its prey on an open and even surface, the abdomen may be as inflexible as in suckers of vegetable juices. Thus the joints coalesce along the middle of the ventral surface, not only in many *Cimices*, but also in many *Reduvii*. In many *Lygæi*, in *Nepæ*, *Nabis*, *Anthocoris*, &c. the edges of the anterior segments meet on a level, whilst the posterior segments are imbricate; but in *Capsi* all the joints are imbricate, and the whole abdomen very moveable, &c. These differences afford in several instances useful marks for groups and genera.

The Rhynchota, which live as parasites on warm-blooded animals and possess a telescope-formed rostrum, are pagiopodous, but must, in accordance with their general structure, be treated as a separate division, *Siphunculata* (Latr.), of equal value with Heteroptera and Homoptera.

IV.

The classification to which the views explained in the foregoing necessarily leads entails, in several respects, such a thorough revolution in the hitherto received arrangement, that it can scarcely look for ready and immediate acceptance by hemipterologists. But nothing will offend them more than the demolition of the division of Cryptocerata, which hitherto has been looked upon as irremoveably established. This division as now accepted is remarkable for uniformity in general appearance, and possesses an easy and decisive character in the short and hidden antennæ; it will there-

fore, first of all, be objected to my classification that it dissolves a natural division which has been long recognized as such, and that it does away with the generally accepted distribution of Heteroptera in *Geocores* and *Hydrocores*. My answer is that Cryptocerata (*Pelegoni*, *Nepæ*, *Naucorides*, *Corixæ*, *Notonectæ*) are not united together except by features which are connected with their life under water, and that *Nepæ* on the one side, and *Notonectæ* and the other families on the other side, are not less different from each other in all points of their structure than *Dytisci* and *Hydrophili* amongst Eleutherata. In *Nepæ* the posterior limbs are moved alternately, as in *Hydrophili*; like these latter, they crawl and climb and row about; and in both families peculiar modifications of certain organs are required in order to facilitate respiration—in *Hydrophili* of the antennæ, in *Nepæ* of the last pair of spiracles: in *Naucorides*, *Corixæ*, and *Notonectæ*, on the contrary, the movement of the posterior limbs is isochronic, as in *Dytisci*; they are like these typical swimmers; and no special arrangements are required for the sake of respiration, as the surface of the water can always be reached without difficulty, not to mention that the highest-developed water-bugs swim with the ventral surface upturned. I anticipate an objection to this—namely, that Cryptocerata show themselves to form a natural division in the structure of the thorax, being the only division of Heteroptera with separate epimera. But this is simply an error: Cryptocerata have undivided thoracic segments like all other Rhynchota; a real open seam between sternum and epimera is never to be found. Nor is it difficult to trace the origin of the mistake. The fact is that each group of muscles belonging to the limbs moulds that part of the thorax to which it is attached into a separate form; and the lines of demarcation between these divisions project internally in proportion as the muscles are stronger; these boundary-lines appear outside as slightly impressed lines, and, on account of their thickness in the depth, they appear with a darker colour when the background is light. The water-bugs, being supported by the medium in which they live, do not require such thick integuments of the thorax as those which live on dry land; their colours are never very dark, never metallic, but generally grey or yellow, in consequence of which the integuments are more even, smooth, and lamelliform than in land-bugs, and the boundary-lines between the parts occupied by different sets of muscles far more striking to the eye. It is likewise an erroneous appreciation of facts when it is stated that the metathorax in *Corixæ* is furnished with "parapleuræ" (that is, epimera separate from episterna); for the coxæ do not at all articulate with

these "parapleuræ," which are nothing but lamelliform projections of the metathorax itself, separated by an indentation, which serves to get more space for the bending forwards of the posterior limb. Nor is this projection peculiar to *Corixæ*, for it occurs also in *Salda*—that is, in quite a different division from Cryptocerata.

How entirely entomologists have allowed themselves to be guided in the arrangement of this division by superficial impressions of general similarity, is evident from the fact that *Naucoris*, merely on account of the oval shape and the strong development of the anterior legs for catching prey, has been placed between *Pelegoni* and *Nepæ*, and separated still further from *Corixæ*, its nearest relatives, by the interposition of *Notonectæ* (see M. Fieber's paper, "Genera Hydrocoridum secundum ordinem naturalem in familias disposita:" Pragæ, 1851, 4to). But, above all, the juxtaposition of *Nepæ* and *Belostomata* in one and the same family shows that classification here has only been founded on superficial similarities. Burmeister, who, like the majority of earlier authors, even reckons *Naucoris* amongst *Nepæ*, and states that all water-bugs of this family respire through tubes which project from the apex of the abdomen, is obliged to add that these respiratory tubes are *wanting* in many *Nepæ*, particularly *in the males*, and that they are also *wanting in the larvæ* (see 'Handb. d. Entomologie,' ii. 192, 195). Fieber attempts, in the paper just quoted, to bring about uniformity in this respect by stating that the so-called respiratory tubes of *Nepæ* do not serve for respiration, but are genital appendages; whilst in his work on the European Hemiptera-fauna, he states that these tubes belong to the genitalia in *Belostomata*, but are of a different, not yet discovered, nature in *Nepa* and *Ranatra*. The truth is that these appendages are fundamentally different in nature and origin in the pagiopodous *Belostomata*, where they belong to the genitalia, and in the trochalopodous *Nepæ*, where they are respiratory tubes. Just as the medium in which the animals live and move requires short antennæ and a felt covering of the ventral surface in all water-bugs, whatever be their typical differences, so a parallelism may be observed also between other modifications of different types of water-bugs; with regard to *Nepæ* and *Belostomata*, we observe it besides in these points—that the side of the metathorax in both is covered by the lateral part of the mesothorax, and that in both the ramified antennæ serve as air-reservoirs.

V.

We arrive here at a point of structure which is still shrouded

in great obscurity, namely the number and position of the spiracles in Heteroptera. Scarcely two authors agree on this subject; and there is no vestige of any one having so much as thought of any fixed rule being observable in this respect.

If, for instance, we turn to the newest manual * (Fieber's well-known and indispensable work on the Rhynchota of Europe), we read (p. 9) that "The spiracles of the body, stigmata, appear only now and then clearly on the dorsal rings, and are, with the exception of some genera of *Hydrocorides*, always to be perceived on the sides of the ventral surface as small perforated knobs (Taf. i. fig. 30, *i*). The spiracles of the thorax are placed on the sides of the metathorax, and show an elongated slit, surrounded by a thick or lamelliform margin (Taf. i. figs. 1, 2, 30, *p*), which sometimes terminates on the outer side in a corniform prolongation (some *Berytidi*, *Oxycareni*). More rarely, each segment of the thorax has its own spiracle." A little before, in treating of the prothorax (p. 7), it is stated :—"The prothorax rarely has a spiracle"; and in treating of the abdomen (p. 8), "The connecting marginal piece, connexivum, which is turned round from the ventral surface to the back (Taf. ii. fig. 2, *b*), carries the dorsal stigmata, which in *Nepa* particularly clearly are covered by a membrane." According to the statement on p. 8, the stigmata of the abdomen are situated on the dorsal surface; according to p. 9, sometimes on the back, but always on the ventral side; the thorax, we are to understand, has only sometimes spiracles between the prothorax and mesothorax, more rarely a pair for each segment, but always a pair on the metathorax. Any reader, however, who understands that the last statement contains a physiological impossibility, and therefore examines M. Fieber's figures in order to obtain further information, will easily perceive, if he is at all conversant with the anatomy of Rhynchota, that what the author represents as spiracles are no spiracles at all, but simply the orifices of the odoriferous glands. It is an old error, and was committed even by Latreille : "Le métathorax des pentatomes, des scutellères offre inférieurement une paire de stigmates" (Règne An. nouv. éd. iv. p. 294, footnote).

The venerable Léon Dufour treated the matter far more

* It is of still less use to consult the general manuals in comparative anatomy, as all they contain in this respect concerning the structure of Insecta and Articulata in general is a confused mixture of a little that is true and a great mass of error; and no one has undertaken to verify the statements and view them from a more comprehensive morphological point of view. This holds good even with regard to the manual of Siebold, to whom, however, no blame attaches, as a better result could not be attained without new and comprehensive investigations.

thoroughly in his highly meritorious and hitherto unique, though now in a great measure antiquated, work on the Rhynchota. He sums up the result of his conscientious investigation in these words:—"Appareil respiratoire formé de stigmates toujours placés à la paroi inférieure du corps . . .; une paire de stigmates pectoraux, quatre, six ou sept paires de stigmates abdominaux" (Rech. Anat. et Physiol. sur les Hémipt. p. 278). This statement is put forth as being valid with regard to all Rhynchota. The only pair of spiracles of the thorax which he knows is placed between mesothorax and metathorax (p. 235); in some cases, however, he simply denies the existence of any spiracles on the thorax, as with regard to *Nepæ*, concerning which he says:—"C'est un fait incontestable que la Nèpe et le Ranatre n'offrent aucune trace de l'existence de stigmates thoraciques" (p. 245). With regard to the abdominal spiracles he specifies his general statement thus, that the common number is six, but that *Miris* and *Capsus* have seven pairs. He mentions this as "un trait anatomique fort remarquable" (p. 243); but he considers it still more remarkable that the female of *Coreus* (*Syromastes*) *marginatus* (L.) has seven pairs, whilst the male has only six; and in treating of the lateral part of the last abdominal segment of the female, he exclaims:—"Mais ce qu'il y a de fort remarquable dans ce repli, c'est qu'il est stigmatifère: en sorte que la femelle de cet insecte a une paire de stigmates de plus que le mâle" (p. 206). In *Nepa* he finds abdominal stigmata only in the third and fifth segments—that is, three pairs in all besides the respiratory tubes, which he considers morphologically separate organs, "indépendant des segmens propres de l'abdomen" (p. 246).

Against these statements concerning *Nepa*, Burmeister observes (Handb. d. Ent. ii. p. 197) that, with regard to the thorax, he cannot fully endorse them, because he has found a pair of spiracles between the metanotum and the first dorsal segment of the abdomen. It escaped Burmeister's attention that Léon Dufour had both described (p. 256) and figured (fig. 196, *e*) this organ, although he had refused to put it in a line with the ordinary spiracles and described it as a "sachet utriculaire." For the rest, Burmeister justly observes that, as these animals fly, they must have spiracles on the thorax; and he modestly adds that, inasmuch as it is well known how very difficult it is to observe these, they might exist in *Nepa*, although so able an anatomist as Léon Dufour had been unable to find them. Burmeister himself had several years before (Handb. d. Ent. i. p. 174) indicated the existence of a pair of spiracles between the prothorax and mesothorax in Rhynchota; and it seems

therefore that afterwards, when the second volume of his manual was published, he did not wish to maintain his former statement as universally correct.

According to my own very extensive investigations, the facts are the following.

Rhynchota heteroptera possess, without exception, ten pairs of spiracles; and their distribution is exactly the same which I have demonstrated long ago in Eleutherata.

The first pair is placed in the connecting membrane between the prothorax and mesothorax. It is in most cases to be found only with great difficulty, and only by a very careful and skilful investigation. It very easily escapes attention on dried specimens, as it cannot be seen till the prothorax is taken away; but in this process the connecting membrane between the segments generally breaks in the very line of the spiracles, which thereby become so lacerated that the remains of their peritrema can only with the greatest difficulty be recognized on the margins of the broken membrane. The proper way of demonstrating these spiracles is to disarticulate the first and second pair of legs, cut out the prosternum and mesosternum together, and then continue the dissection from above; when the ventral surface is cleared, more and more of it is cut away until the connecting membrane is isolated. The same proceeding may be used on dried specimens by first boiling them a couple of minutes, or longer, according to the size of the specimens.

The second pair of spiracles is rightly described by earlier authors; it is hidden behind the seam between meta- and mesothorax, and is visible only when the animal exerts itself in flying or running. In *Nepæ* and *Belostomata*, where its existence has hitherto been denied by all, it is nevertheless in its ordinary place and of considerable size. The reason why it has hitherto escaped detection is, that these animals possess a very remarkable arrangement to prevent the entrance of the water, the epimera of the mesothorax being continued in the shape of a lamelliform cover, reaching beyond the metathorax to the base of the abdomen. This has not been observed; and the spiracle has been sought in vain because entomologists have sought it under the edge of this cover, which has been mistaken for the suture between the two segments, instead of looking for it under the real suture. This latter is not to be seen before the cover is removed to a little way in front of the second pair of coxæ, when the spiracle appears very clearly. It is only near its edge that the cover is close-fitting; further forwards the metathorax is so much inflected as to leave a considerable air-reservoir between it and the

cover outside the spiracle. It is easy to see the importance of these arrangements for the respiration of the *Nepæ*. They come to the water flying, no doubt after long-continued search, and with the walls of the thorax violently distended by the exertion of the thoracic muscles; and in the same moment that the water closes over them they must dispense with the means of respiration of which they made use during flight. It is therefore a matter of the greatest importance to them to be able under all circumstances, merely by closing the covers formed by the metathorax, to get time to recover without danger of suffocation; they are thus rendered independent of the surrounding medium, until they can begin to make use of their respiratory tube. Something similar must hold good with regard to *Belostomata*, though their respiratory system is otherwise so different from that of *Nepæ*; but nothing further is known with regard to the circumstances of life of these tropical animals.

The third pair of spiracles is placed on the back of the animal, hidden by the wings, between the metanotum and the first dorsal segment of the abdomen. It has hitherto only been observed in *Nepæ*, as stated above, but exists really in all Heteroptera. It is large, and those who are sufficiently conversant with the structure of spiracles will not fail to see it; but others will easily be deceived by the various membranes which are placed between the places of insertion of the wing-muscles and the roots of the ribs of the wings. This is the pair which I have called spiracula metathoracica in Eleutherata, giving to the two anterior pairs the names respectively of spiracula prothoracica and mesothoracica; and in the choice of this name I have been guided by the fact that this third pair of spiracles does supply the metathorax with tracheæ. It seems to me that no more striking proof of the justice of this view can be demanded than the fact that these spiracles, together with that dorsal segment which is situated behind them, are moved forwards to join the thorax when the abdomen becomes pedunculated.

The fourth and following pairs, including the tenth, are placed on the ventral side of the pleural fold of the abdomen. There are consequently seven pairs of abdominal spiracles; and that entomologists hitherto have only known of six pairs, or in some cases of one pair more in the female, has a double cause. In the first place, the projecting posterior margin of the metathorax covers, in many trochalopodous bugs, as we have shown, a greater or smaller part of the first abdominal segment, together with the spiracles of this segment, which in that case do not become observable till this marginal plate

is removed. In the second place, a collision arises between the exigencies of the seventh pair of spiracles and the modification of the last abdominal segment for the purposes of generation, in consequence of which the spiracle often is so effectually hidden out of sight that it is not observed till the segment is entirely lifted out. In the females the pleural fold remains broader than in the males; and it must therefore be accidental, or perhaps rather owing to a want of perception of the general law, that Léon Dufour saw it only in the female of *Syromastes marginatus* and not in those of other *Cimices* and *Corei* in general. But in the males the last ventral segment is made use of for the organs of copulation to a much greater extent; and the pleural fold is so much reduced in extent that, as stated, the spiracle quite disappears from view and is not seen till the middle part of the segment is entirely taken out of its connexion; but with proper attention it can then always be seen. That Léon Dufour only saw it in *Capsus* and *Miris* was because the last abdominal ring is more moveable in these genera than in all other Heteroptera.

A more detailed account of the structure of the organs of respiration would be beyond the scope of the present treatise; and I shall therefore confine myself on this occasion to a short notice of a few points which are too closely connected with the preceding to be entirely passed over in silence.

The abdominal spiracles are round and open in all bugs living in the atmospheric air; but in those which live under water, they are partly modified in various ways, partly accompanied by special arrangements. In *Nepæ* the first two and the penultimate pairs are exceedingly small and apparently closed; the third, fourth, and fifth pairs very large, but closed by a plate presenting the appearance of a sieve, whilst the seventh is prolonged into a pair of air-tubes. The extremely remarkable structure of the large spiracles, however, as well as of the two which are situated behind the prothorax and behind the metanotum respectively, has not yet been properly demonstrated, and requires a new and thorough investigation. On the present occasion I shall only mention this essential fact, which is of importance for the following, that from the seventh pair (the respiratory tubes) two large trunks of tracheæ run through the whole length of the body*. In

* Comp. Léon Dufour's celebrated and often-copied figure 196 in 'Rech. Anat. et Physiol. sur les Hémipt.'; it gives a good elementary view of the arrangement, but is, as will appear from the preceding observations, very inaccurate and incomplete as far as the whole fore part is concerned, where the author has accommodated it in accordance with his assertion that the thorax is entirely without spiracles.

all the pagiopodous water-bugs all the spiracles of the abdomen are uniform and open, but turn their openings outwards and backwards, not downwards, in consequence of which they are difficult to find, unless the ventral surface is carefully examined in this very slanting position; outside them the pleural fold bears either an aëriferous border of hair (*Notonectæ*, where these borders, in connexion with the keel of bristles along the ventral surface, form a complete roof over the layer of air), or of short close felt (*Belostomata*), or else the whole ventral surface is closely covered by short felt (*Naucoris*, *Corixæ*); and from each spiracle a large trunk-trachea proceeds to the interior, whilst the two large longitudinal trunks characteristic of *Nepæ* are here wanting.

Mistakes with regard to the spiracles of the abdomen have often been caused by the occurrence in most bugs of a series of impressions, sometimes having the appearance of short lines, sometimes of slightly impressed spots of a lighter colour than the surrounding ventral surface, sometimes of more or less deep points, which series is placed alongside the row of real spiracles, in most cases inside it, sometimes outside, or there may even be a row of impressions on each side of the row of spiracles. Inasmuch as these impressions, owing to their size and their colour, stand out in stronger contrast to the ventral surface than the spiracles, they have often been mistaken for these, though the absence of an opening, or of any thing that might be taken for the peritrema of the spiracles, easily convinces an attentive observer of the true nature of these impressions. These correspond to protuberances on the inside of the segments, which serve as points of attachment for a very complicated apparatus of ligaments and muscles whereby the trunk-tracheæ which spring from the spiracles are closed and opened.

VI.

In the foremost part of the abdominal cavity of Heteroptera two large, orange-coloured glandular sacs are observed, the odoriferous glands. Their secretion, an ethereal oil, is the source of the peculiar penetrating smell which is so well known from the common bug, but which in many other species is rather to be described as aromatic than as disagreeable. Léon Dufour has described the main features of these glands in several genera. I shall here confine myself to noticing their external apparatus, which in several cases, as already mentioned, have been mistaken for spiracles. The two ducts open on the metathorax. A distinction must be made between the *spout* with which the opening is often fur-

nished, the *spout-groove*, which sometimes occurs as a continuation of the spout, and, finally, the *evaporating-surface*, which surrounds the opening and is intended to retain the secretion while it evaporates, and to prevent it from running down over the neighbouring parts, particularly the second pair of spiracles. To this end the surface is very finely granulated, and at the same time undulated-rugose. In the detail of their structure these parts exhibit so many varieties, that they are often of importance for the systematic diagnosis of the animals; and as they have hitherto been very little noticed, a general account of their distribution and principal forms will be of use. I shall principally take the examples from among the Danish species, which are quite numerous enough (more than three hundred species are known from Denmark).

In the family of *Cimices* there are some in which there seems to be no external indication of a glandular apparatus; amongst the Danish genera, *Phimodera* and *Odontoscelis* are in this case. In the others the opening is always situated on the side, at a greater or smaller distance from the coxæ, but exhibiting many varieties as to size, shape, spout-groove, and evaporating-surface. In *Tetyra hottentotta* and *maura* the opening is at a distance both from the coxæ and from the anterior edge of the metathorax; it is very narrow, and has a long straight groove, with narrow and sharply raised edges, and terminating with a sharply defined rounded outline; the evaporating-surface extends only to the metathorax, but is very large, surrounds the whole apparatus, and is externally bounded by a sharply defined arched line. *Coreomelas* and *Legnotus* have a highly developed, long, raised sprout-groove, extending along the suture of the mesosternum, and terminating in *L. picipes* with a projecting tooth; the evaporating-surface is very large, and extends backwards, more or less sharply defined, over the metasternum, covers the whole suture of the mesosternum, reaches some distance beyond the mesosternum, and sends a continuation forward along the margin of the elytra. In *Podops*, *Ælia*, *Cimex melanocephalus*, *vernalis*, and *baccarum*, the opening is small, lateral, without a proper spout-groove; the evaporating-surface is extensive, and forms an oval spot which covers the suture between metasternum and mesosternum. In *Strachia* and the other members of the same group the opening is nearer to the coxæ, there is no spout-groove, the evaporating-surface is small, and does not stretch so far inward as to reach the metasternum. The other Danish species of *Cimices* have a well-developed, long spout-groove, of which the external extremity is specially

observable in *C. pinicola, prasinus, nigricornis*, and *rufipes*, on account of its black colour, whilst the sternum is green; the evaporating-surface in all these species is very large, and reaches so far as to occupy part of the mesosternum.

A similar arrangement to that of these species of *Cimex* is seen in *Acanthosoma*; the extremity of the spout-groove projects considerably in *A. lituratum*, which at the same time is distinguished from the other Danish species of this genus by a remarkable round black spot on the green chest, immediately under the point of the spout-groove. *Asopus*, too, has a long spout-groove, but the evaporating-surface is here very small and restricted to the metathorax; at the same time both it and the spout-groove vary according to the species. The spout-groove is of a red colour, with a metallic-green point in *A. bidens*, whilst the underside of the thorax is yellowish grey, with black spots; in the other species the groove has the same colour as the chest generally, with a black spot in *A. luridus* before the point; the groove reaches as far as the anterior edge of the metathorax in *A. sanguinipes*, but terminates in our other species before reaching the margin; it is short and straight in *A. punctatus*, long and curved in the others; in *A. punctatus* only the anterior border is raised, whilst in the others both margins are swollen; in *A. bidens* the fore margin is twice as thick as the posterior margin; in the others the two margins are equal. The evaporating-surface is of a dull black, whilst the chest is of a metallic green, in *A. cæruleus*; in the other species it is of the same colour as the chest: it reaches entirely round opening and spout in *A. luridus* and *A. bidens*; but in the other species it only covers the space immediately inside the opening of the duct, and is continued from there a shorter or longer distance outwards along the sides.

In *Corei* the opening is situated nearer the coxæ, or even in the middle of the sternum, between the posterior and the second pair of coxæ. In *Syromastes* and *Coreus* it is lateral, turned outwards, forming a short, widely open split, with very raised margins, and without a spout-groove; the evaporating-surface is not plainly circumscribed, it surrounds the opening, and has a narrow prolongation on the mesothoracic suture. In *Pseudophlœus nubilus* the opening is close to and in a line with the second pair of coxæ, is long, wide open, with highly raised borders, and a projecting, very short spout-groove broadly rounded at its extremity; the evaporating-surface is not plainly defined, and occupies both sides of the mesothoracic suture. In *Alydus* the large oblong opening is placed on the sternum close in front of the third pair of coxæ; it has

sharply defined, highly raised edges, but no spout-groove; the evaporating-surface forms a narrow ring round the opening and a small spot in front of this. In *Corizus crassicornis* the opening, which is placed far inwards on the sternum, is exceedingly small and difficult to find, punctiform, without spout-groove or evaporating-surface; whilst our other species of *Corizus* have a large, wide opening between the coxæ, without spout-groove, the evaporating-surface forming a narrow sharply defined strip covering both sides of the suture between meta- and mesothorax, of which latter the edge is finely and shortly pectinato-dentate. Our two species of *Chorosoma* agree in this respect with *Corizus crassicornis*. In *Berytus* the evaporating-surface is very large, quadrangular, reaching the mesosternum, and behind sharply separated from the arched epimeron; the opening is small, situate on the sternum, has in *B. crassipes* and *clavipes* no spout-groove, but in the other species a long, curved, sharply defined groove, terminating externally in *B. elegans* with a tooth. In *Aradi* and *Tingidæ* the opening, wherever I have succeeded in discovering it, is exceedingly small, punctiform, destitute of spout-groove or evaporating-surface.

In the family of *Lygæi* there is less variety. The opening of the duct is generally near to the second pair of coxæ. In *Cymus glandicolor* and *Caricis* it is oval, the edges projecting, almost forming a tube, and externally prolonged into a short spout, but there is no evaporating-surface; in *Cymus didymus*, on the contrary, the spout is continued into a long groove, terminating in a point which projects from the body like a dagger, and the entire under surface of the thorax is developed as evaporating-surface. *Chilacis* agrees more nearly with the two preceding species of *Cymus*, except that the margin of the opening is very little raised. In *Nysius* the opening forms a long slit, with highly raised margins and short rounded spots; the evaporating-surface occupies the entire side of the metasternum, excepting the borders. In *Phygadicus* and *Lygæus* the form of the opening is as in *Nysius*, but there is no evaporating-surface. The numerous species of *Rhyparochromus* vary but little amongst themselves: the opening with its short spout is generally slightly curved, and but little raised above the general surface of the body; and the evaporating-surface forms an indistinctly defined, almost quadrangular spot on the side of the metasternum; only in the group of *Stygnocoris* the opening is more round, with tubiform projecting margins and very short spout. In *Geocoris* the opening is oblong, with highly raised margins, but the evaporating-surface is confined to an indistinctly

defined ring round the opening. *Ischnodemus* is distinguished by a lateral opening situated on an elongated protuberance, of which the margin projects outwards round a long pointed spout, which is considerably raised; the evaporating-surface is as in *Rhyparochromus.*

Hydrometræ and *Nepæ* seem to be entirely destitute of odoriferous glands; I have at any rate searched in vain for any external opening.

In *Reduvii* these organs are generally very little developed. It is exceedingly difficult to find the small punctiform openings of the ducts, which are placed in a small impression close in front of the posterior pair of coxæ; and in many species of this family I have sought them in vain. Only in *Nabis* the openings are shaped like a slit, and rendered still more observable by the existence of a slightly impressed, narrow spout-groove, which is continued, close in front of the posterior coxa, a little way upwards, on the side of the metasternum; but there are only slight vestiges of an evaporating-surface.

On account of the considerable development of the second, and still more of the third pair of coxæ, in Pagiopoda, the lateral part of the metasternum becomes very narrow and pointed, and the place for the glandular apparatus therefore more confined. In *Capsus* the lower extremity of the side of the metasternum is occupied by a small evaporating-surface, which is generally bounded by a distinct transverse line, and in its middle exhibits the opening of the duct, with more or less raised margins, but very short spout. The variation in shape is but small; the groups of *Pithanus* and *Melanocoris* are distinguished by the considerable development of the margin. In *Miris* the opening varies more; but the evaporating-surface is generally less developed, and less sharply defined. In *Miris*, sens. strict., the posterior lip of the spout is continued into a short thick knob; but in the groups of *Notostira* and *Leptopterna* the whole of the short spout is considerably raised; in the group of *Trigonotylus* the opening is very fine, with short narrow spout-groove, of which the margins are very slightly raised; but the most remarkable arrangement is that of the group of *Teratocoris*, where the opening is still more minute, punctiform, and hidden between the last two pair of coxæ, in consequence of which it is difficult to discover, unless the coxæ of the second pair are removed: both groove and evaporating-surface are wanting. In *Anthocoris*, *Xylocoris*, and *Acanthia*, the whole of the metasternum is developed as an evaporating-surface; the opening is rather large, the spout-groove sharply and deeply cut, but

varying in shape and size; in *Anthocoris* it is short and straight; in the two other genera long and curved; in *Acanthia* it is raised in the shape of a leaf directed backwards, and receding as far as the suture of the mesonotum. In *Myrmedobia* and *Microphysa* the opening is small, groove and evaporating-surface slightly developed. Neither in *Saldæ* nor in *Pelegoni*, nor in the swimming Heteroptera, *Notonectæ*, *Belostomata*, *Naucorides*, and *Corixæ*, have I been able with certainty to discover any external opening which could be supposed to belong to the glandular apparatus, although this must exist at least in some of them. *Corixæ* are more particularly accompanied by a very perceptible bug-smell, and I have convinced myself that the odoriferous glands exist in them; but I have not succeeded in finding their external openings.

VII.

In accordance with the preceding considerations, I propose the following classification :—

I. Genæ excavatæ, coxas primas excipientes.

[Coxæ posticæ cardinatæ, scrobiculis femoralibus instructæ.]

Subordo Homoptera.

II. Genæ integræ, a coxis remotæ.

Subordo Heteroptera.

A. Coxæ posticæ acetabulatæ, rotatoriæ, scrobiculis femoralibus nullis : *Trochalopoda.*

a. Epimera metathoracica laminata, segmentum primum ventrale abdominis obumbrantia.

1. Antennæ basi obtectæ. Fam. 1. *Cimices.*

2. Antennæ totæ detectæ.

* Antennæ præoculares. Fam. 2. *Corei.*

** Antennæ infraoculares. Fam. 3. *Lygæi.*

b. Epimera metathoracica lamina ventrali carentes.

1. Unguiculi superpositi. Fam. 4. *Hydrometræ.*

2. Unguiculi terminales.

* Epimera metathoracica maximam partem epimeris mesothoracicis obtecta. Spiracula abdominalia ultimi paris siphunculata. Fam. 5. *Nepæ.*

** Epimera metathoracica tota detecta. Spiracula abdominalia æqualia. Fam. 6. *Reduvii.*

B. Coxæ posticæ cardinatæ, scrobiculis femoralibus instructæ : *Pagiopoda.*

a. Antennæ detectæ. Fam 7. *Acanthiæ.*

b. Antennæ obtectæ.

1. Corpus depressum, pronum.

α. Rostrum liberum.

† Epimera metathoracica detecta.

* Pedes cursorii. Fam. 8. *Pelegoni.*

** Pedes natatorii. Fam. 9. *Naucorides.*

†† Epimera metathoracica maximam partem epimeris mesothoracicis obtecta. Fam. 10. *Belostomata.*

β. Rostrum obtectum. [Epimera metathoracica detecta, appendiculata.] Fam. 11. *Corixæ.*

2. Corpus naviculare, supinatum. [Epimera metathoracica detecta. Rostrum liberum.] Fam. 12. *Notonectæ.*

XXIII.—*Notulæ Lichenologicæ.* No. XXXIII.

By the Rev. W. A. Leighton, B.A., F.L.S., F.B.S. Edin.

In the 'Flora' of 1864, p. 487, Dr. Nylander proposed to place *Endocarpon Guepinii*, Delis., in a new genus, which he named *Endocarpiscum*, on account of the thallus containing "granula gonima." Dr. Hepp had previously arranged this lichen in a a new genus, *Guepinia*, because the asci were polysporous. But as *Guepinia* had already been appropriated by Fries to a genus of the Hymenomycetous Fungi, the name could not be used amongst Lichens.

Recently Dr. F. Baglietto, in Nuova Giorn. Bot. Ital. vol. ii. p. 171, has instituted a careful microscopical examination of the fructification in its progressive stages, and finds that, although in an early stage it is pyrenocarpous, yet in maturity it becomes gymnocarpous, and expands into a perfect patellulate apothecium. On this account he proposes to constitute it a new genus, *Guepinella*, which he considers to be systematically near to the genus *Heppia*, Näg., in the family of the Peltigerei. He gives the following diagnosis :—

Guepinella, Bagl.

Apothecia thallo primum inclusa, sensim aperta urceolato-saccata, demum perfecte discoidea a thallo elevato margi-

nata. Lamina proligera tenuis, ceraceo-gelatinosa, e strato gonimico enata, excipulo proprio destituta. Sporidia exigua, simplicia, hyalina, in ascis elongatis polysporis. Thallus cartilagineo-coriaceus, umbilicatus, monophyllus.

Guepinella myriocarpa, Bagl.

Thallus cartilagineo-coriaceus, umbilicatus, subrotundatus, ut plurimum undulato-lobulatus, supra viridi-olivaceus, marginibus tumidulis, reflexis, albido-griseis, subtus nudus et carneo-fulvus. Apothecia discreta, quandoque contigua, primum punctiformi-verrucarioidea, matura discoidea; disco nudo, fusco-rubiginoso, humecto sanguineo, lamina proligera iodi ope cærulescit. Asci polyspori, crebri, elongato-clavati, basi subpedicellati. Massa sporigera apice mucronis ad instar constricta membrana ascorum propria conspicue breviore. Paraphyses capillares subflexuosæ, apice pallide aurantiaco incrassato. Sporidia exigua, elliptica, obtusa, simplicia, hyalina.

Syn. :—*Endocarpon Guepini*, Delis. in Duby et DC. Bot. Gall. 594; Fr. L. Europ. 410; Mont. in Arch. Bot. vol. ii. 304; Schær. En. 233; Nyl. Prod. 175, Expos. Syn. Pyren. 13; Körb. S. & G. 101; Bagl. Esc. Lich. in Comment. Crittog. Ital. i. 344, & vol. ii.; Bagl. e Cares. Catal. Lich. Vals. 413; Anzi, Catal. Lich. 102.

Exs. Schær. 598; Erbar. Crittog. Ital. ser. 1. 391; Rabh. Lich. Eur. 621; Anzi, Langob. 233.

Specimens of *G. myriocarpa*, Bagl., exist in the Hook. Herb. at Kew, from Dr. Mougeot, Vosges; and Swan River (Drummond, 92), authenticated by Dr. Nylander as *Endocarpon Guepini*, Delis.

XXIV.—Professor Häckel *and* Mr. E. Ray Lankester *on the Affinities of the Sponges.* By W. Saville Kent, F.Z.S., F.R.M.S., of the Geological Department of the British Museum.

Fresh from the learned Professor's lecture-room, a more worthy champion of Häckel's doctrines than my friend Mr. E. Ray Lankester could scarcely have been lit upon; and the only matter of surprise to myself has been that the champion so long delayed his advent.

The whole force of Mr. Lankester's argument turns upon a misinterpretation of my views, which I must immediately rectify; beyond this he has not a single fact to oppose in refutation of the views he combats; and his statement regard-

ing the destructible nature of my position is, to say the least, somewhat premature.

When admitting that, far back in the remote ages of time, there probably did exist a something equivalent to Prof. Häckel's *Protascus*, the expression was meant to carry with it the vaguest possible significance, and simply as an acknowledgment of my faith in the doctrine of evolution. The whole tenor of my paper bears me out in this assertion; and I was also then under the impression that Häckel himself sought to convey nothing further. Referring once more to his article, however, I find he supposes this organism to be sac-like, with a single terminal orifice—a view which I certainly had and have no intention of indorsing, all the evidence attainable directly controverting instead of favouring such a proposition. *Protascus* is a simply theoretical form, which in my estimation would serve equally well for the prototype of half a dozen other at present distinct groups of the Invertebrata as for that of the Sponges and Corals. The open sac-like contour of all existing Cœlenterates and a few *exceptional* Spongiadæ has probably been arrived at by two very different processes of evolution; and every grain of evidence, analogical, histological, and "*psychical*," we can bring to bear upon the subject, most directly favours this interpretation.

Homological or "*homogenetic*" (taking the liberty of borrowing from Mr. Lankester's armoury) affinities, in the very strictest sense of the term, we can establish none; and analogical ones are, as Mr. Lankester himself admits, but small indeed, if they must not altogether subside into mere resemblance of outward form, or, at the most, "*homoplastic*" affinities. These considerations have, however, already been discussed in my former paper, and need not be repeated here.

Mr. Lankester criticises the use I make of the terms "homology" and "analogy," which have unfortunately in the hands of different naturalists received an almost equal number of modes of interpretation; and Mr. Lankester himself, in evident despair of defining their limits by other means, finds it necessary to preface his criticisms with a paper in which, by the introduction of several new terms, he ingeniously achieves the required end. These new terms he makes use of in his criticisms—a mode of attack, at all events, bearing the stamp of high originality. At the time of penning my first paper, unfortunately these had yet to be evolved, and the old terms enjoyed the most protean significance.

Mr. Lankester's newly forged weapons, however, are brought forward to do battle with a shadow; while at the same time the new ray of light, now illuminating and defining the exact

boundaries of the terms in question, materially assists us in demonstrating what little practical use we can make of them in attempting to establish the close affinities of the Sponges to the Corals.

Mr. Lankester next objects to my making use of psychical manifestations in instituting comparisons between the two groups; and may not this be said to display unexpected evidence of the "conservatism" with which he taxes me? In seeking to solve Nature's truths, should we take a one-sided or two-sided view of the case alone, or bring all the light and evidence we can to bear on every point? Mr. Lankester's verdict appears to be in favour of the former alternative.

Mr. Lankester accuses me of persistently comparing extreme forms: the ideal diagrammatic sponge-body I made use of in illustration was exaggerated to an amount of radial symmetry never really occurring, in order to strain the comparison as much as possible in Häckel's favour.

At the same time Mr. Lankester does not hesitate to quote the highly individualized forms *Euplectella* and *Grantia*, and to enumerate all the most complex structural qualities possessed by any Porifera, in his scarcely successful endeavour to show that "there is really an enormous gap between Sponges and those Protozoa which come nearest them."

Mr. Lankester's third objection to my remarks is his charge of conservatism, or, as it would appear, an undue regard for authority. Doubtless Mr. Lankester's views on this subject are very different from my own; but in the outset of life I willingly confess to feeling a very high regard for the opinions and experiences of those veterans in science who occupy the foremost ranks.

The fourth objection, and, in Mr. Lankester's estimation, the "clearest evidence of weakness" I display in my opposition to Häckel's views, is my proposition that the Sponges should still be collated with the Protozoa—a subkingdom, as Mr. Lankester most sagaciously suggests, including in addition the classes of the Amœboidea, Foraminifera, Gregarinæ, Radiolaria, Infusoria, and possibly the Monera.

This "disorderly lumber-room" (the expression is somewhat conservative, carrying with it the aroma of authority), as Mr. Lankester designates the subkingdom, he considers demands a change more than any other; but he does not propose any practical improvement, neither would the carrying-out of Prof. Häckel's latest views on this subject effect so desirable an end. All systems of classification are more or less ideal, and simply subordinate to our convenience, facilitating our clear conception of the relations of Nature's myriad

forms. The progress of science, and the unveiling to us of innumerable other hitherto unknown varieties, will serve but to demonstrate still further that ideality; but at the same time the more natural the system of grouping we adopt and the closer the bonds of affinity existing between the subordinate sections of these groups, the more perfect and intelligible must that system of classification become, and the more clear and correct our contemplation of the vast whole. Because the affinities of the lowly organized animals forming the Protozoic subkingdom have hitherto considerably baffled our comprehension, are we to give up the task in despair, and scatter them among other well-defined groups, and thus increase instead of diminish our difficulty? A "disorderly lumber-room" may be set in order and converted into a well-appointed apartment without having recourse to pitching the furniture out of the window. Already even, within the last few years, the *cordon* has been gradually closing in around these Protozoa, showing with what justice the Spongiadæ have been collated with the other representatives of the group; and the "enormous gap" separating the one from the other, which Mr. Lankester conjures up, dwindles into insignificance when we contemplate the structure and properties of the Flagellate Infusoria, recently made known to us by the praiseworthy and patient investigations of Mr. James-Clark, or, on the other hand, of such Radiolaria as Mr. Archer's newly described genera *Raphidiophrys* and *Heterophrys.*

The "enormous gap," again, is well nigh spanned by representatives of the Foraminifera. *Squamulina scopula* (Carter)* was first considered to be, and described as, a Sponge by Dr. Bowerbank. It devolved upon Mr. Carter to discover its true nature; and in recording it, he remarks upon the "nice distinctions that exist between the Foraminifera and the Sponges, especially in the minuter forms." The pathway to the other Protozoa is clear enough.

Professor Häckel's brilliant theory is deserving of the greatest praise; but theories without facts to support them are but of little value; and when, instead of this, we find that facts militate against them, their acceptance must necessarily

* Mr. Carter takes objection to Dr. Bowerbank for having referred this organism to the Spongiadæ, after having observed that the "globular heads" of the spicules were directed outwards, a mode of arrangement which had not then been known to occur. An illustration of the unreliable nature of negative evidence only is afforded in the pages of this Magazine (p. 217), where, under the name of *Rhaphidotheca Marshall-Hallii*, I describe a Sponge which possesses this arrangement of its "spinulate" spicula as one of its most characteristic features.

lead to error, and the cause of science suffers rather than benefits by their adoption.

Had the learned Professor's proposed scheme of collating the Spongiadæ with the Cœlenterata offered an evident improvement on the existing arrangement of the two groups, and really bestowed upon the Sponges a more "intelligible position in the classification of organisms" than they now possess, none would have been more open to conviction or would have more warmly advocated its general acceptance than myself; as it is, the step would be but one of retrogression. The day may arrive when an organism will be discovered embodying the characters of the two groups in such a manner that it will be difficult to draw a line of demarcation between them, and their coalescence will be rendered necessary; but at present the merest tyro in zoology discriminates unhesitatingly between a Cœlenterate and a Protozoan, let the latter belong to the Spongiadæ, Radiolaria, or Amœboidea.

Whether *Prosycum* may or may not be regarded as the veritable stock-form of the Calcispongiæ must remain an open question, though maturer reflection would rather induce me to search for it among the allies of *Clistolinthida.* Even Prof. Häckel himself admits that the Sponges without flue or osculum are probably primitive sponge-forms.

I would also venture to express doubts whether it is among the Calcispongiæ we are to seek the form most closely connecting the Cœlenterata with the Protozoa, recent observations on certain living Silicea and on Calcarea or Calcispongiæ having afforded me the greater amount of evidence in favour of the former group.

Mr. Lankester refers to *Protohydra*, a Hydroid Zoophyte devoid of tentacles, and consequently simply sac-shaped. *Lar sabellarum*, again, has only two tentacles; and there are numbers of Anthozoa in which these appendages are almost altogether rudimentary; but no difficulty has ever been experienced in determining the cœlenterate nature of these animals. Such an organism as a simple sac-shaped Sponge, without a supporting skeleton of some kind or other, from the very nature of its substance, could not exist; as with the young lady of the period, tight lacing and whalebone must be represented by spicula or reticulated fibres to preserve its shapeliness; the Hydrozoon, on the other hand, is built up of firmer stuff, and is independent of mechanical means of support.

These considerations suggest the following relative to Häckel's hypothetical sac-shaped *Protascus.* In the first place we must assume that organism to have been far simpler than either the existing Sponges or Corals which he supposes to

have been evolved from it. The Sponges, it is on all sides admitted, are the simpler of the two. If simpler than the Sponges, its nature must have been Protozoic; and, knowing what we do of the highest representatives of the Protozoa, we may suggest the following:—

1. The simplest Sponges have no skeleton.
2. Sponges with skeletons are highly developed forms.
3. All cup- or sac-shaped Sponges have skeletons.
4. Prototype Sponges probably had no skeleton.

∴ Prototype Sponges, including *Protascus*, were not cup-shaped.

The word *Protozoa* may be substituted instead of Sponges in the foregoing lines. The reasoning is, as a matter of course, partly hypothetical, and is not laid down dogmatically; yet it is theoretical evidence in addition to the far graver one of facts opposed to the probability of Professor Häckel's hypothesis.

Mr. Lankester has evidently not made himself familiar with the Palæozoic Zoantharia, or he would scarcely have contradicted so emphatically my suggestion that in that remote epoch the Corals had already reached the zenith of their development. Should he feel inclined to further cultivate their acquaintance, he may encounter forms far more complex than those peopling the existing seas.

One sentence in Mr. Lankester's criticism of my paper is somewhat obscure, viz.: "We must also remember that the *currents* directed by cilia in the Sponges and the *contractile organs* round the mouth of Actinozoa are special developments gradually attained by these two diverging stocks which their common parent possessed but in general outline." The "homology," "homogeny," or "homoplasy" existing between an organ and a result is difficult of comprehension.

XXV.—*On two Species of Land*-Planariæ *from Borneo*. By the Rev. W. Houghton, M.A., F.L.S.

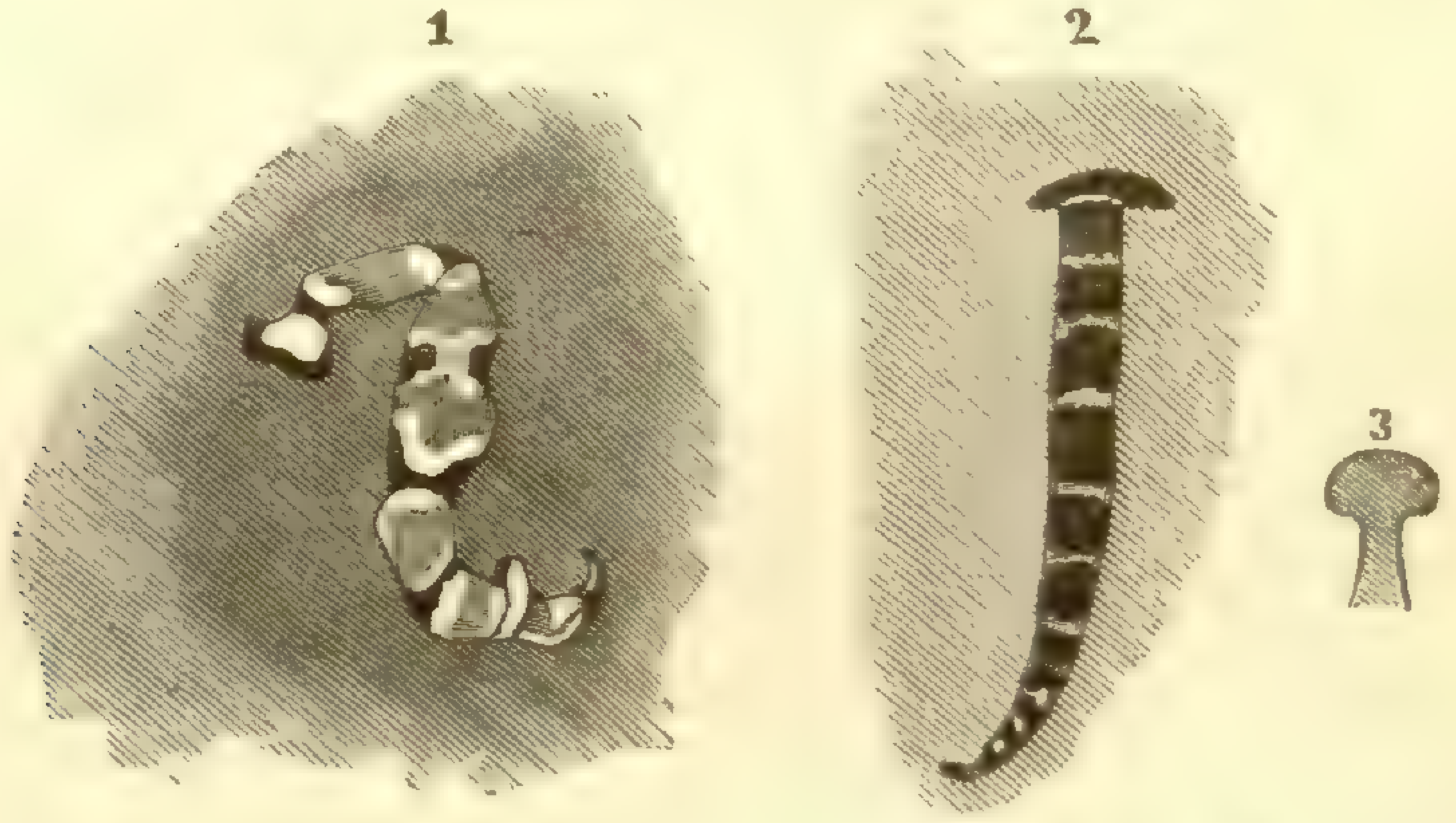
To the Editors of the Annals and Magazine of Natural History.

Gentlemen,

I have received the enclosed sketches of two species of Land-*Planariæ* from Mr. Alfred Everett, Sarawak, Borneo, concerning which I shall be glad to receive what information any of your correspondents can give. Mr. Everett does not tell us any thing of the internal anatomy of these worms; but of their external form he thus writes:—

"No. 1 is taken from a living specimen, and is pretty accurate; it was found on a leaf below Tambursan Cliff. The

body is extremely mobile, exuding a plentiful and very tenacious mucus; the stripes do not quite meet below, where the orange tint is lighter. Body capable of much elongation; the black transverse stripes are encircled by a halo of light yellow. Length, when extended, $2\frac{2}{3}$ inch. No. 2 is merely a sketch from memory; but having since seen another individual of the same species, I am able to correct it. The frontlet when



at rest is semilunar, as in No. 3, and the lateral extensions I have given it are exaggerated. The white stripes should not be so regular—white being rather the ground-colour, and dark blackish brown banding and marbling it rather irregularly. Both kinds are of much the same size; and there is nothing in their externals to prohibit their being included as members of one and the same genus. No. 1 was discovered by my brother, Mr. Harold Everett, the other by myself."

Mr. Everett adds that he has been unable to detect any Planarian worms in the fresh waters of the part of Borneo where he resides, but that the hot and humid jungle seems to be favourable to the existence of terrestrial species.

I believe that little attention has hitherto been given to the study of these Turbellarian worms; and it is much to be hoped that Mr. Everett will extend his observations and give us further particulars relating to the species he may meet with in Borneo. Years ago Mr. Darwin described several species of foreign Land-*Planariæ* in your pages (see Ann. Nat. Hist. 1844, vol. xiv. p. 241). Various genera have been found in America, Ceylon, Australia, &c. One species of Land-*Planaria* (*P. terrestris*) has been observed in this country, first by Mr. Jenyns in plantations at Bottisham Hall (see 'Observations in Nat. Hist.' p. 315)—who, correctly identifying his species with the *Fasciola terrestris* of O. F. Müller (Verm. Terrest. et Fluviat. p. 68), called it "the ground-fluke,"—secondly by Sir John Lubbock, Bart., in the plantation of High Elms (Journ. Linn. Soc.

vol. x. No. 43); and, thirdly, by myself in damp earth of a field opposite my house, and also under decaying fungi in the woods of Ercall Heath, Shropshire. Mecznikow (Bull. de l'Acad. Imp. d. Sciences de St. Pétersbourg, sér. 5. vol. v.) has described a form of Land-*Planaria* which he discovered in the Botanical Gardens at Giessen a few years ago, under the name of *Geodesmus bilineatus*. This, I am certain, is quite distinct from the *Planaria terrestris* of Dugès (Annales des Scien. Nat. vol. xx.), since found in England by at least three individuals. I still adhere to my opinion that the English species, which is identical with the *Fasciola terrestris* of Müller and the *Planaria terrestris* of Dugès, is a true *Planaria*, differing from that genus in no essential anatomical particulars. Prof. Grube has a memoir "Ueber Landplanarien" (in Jahresbericht der Schles. Gesellsch. f. vaterl. Cultur, 1866, pp. 61–64), but I have had no access to it. Would you kindly give in your pages an abstract of that memoir?

I remain, Gentlemen,
Yours faithfully,
W. HOUGHTON, M.A., F.L.S.

Preston Rectory, Wellington, Salop.
August 12, 1870.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

April 28, 1870.—Dr. William Allen Miller, Treasurer and Vice-President, in the Chair.

"On an Aplanatic Searcher, and its effects in improving High-power Definition in the Microscope." By G. W. ROYSTON-PIGOTT, M.A., M.D. Cantab., M.R.C.P., F.R.A.S., F.C.P.S., formerly Fellow of St. Peter's College, Cambridge.

The Aplanatic Searcher is intended to improve the penetration, amplify magnifying-power, intensify definition, and raise the objective somewhat further from its dangerous proximity to the delicate covering-glass indispensable to the observation of objects under very high powers.

The inquiry into the practicability of improving the performance of microscopic object-glasses of the very finest known quality was suggested by an accidental resolution in 1862 of the Podura markings into black beads. This led to a search for the cause of defective definition, if any existed. A variety of first-class objectives, from the $\frac{1}{16}$ to the $\frac{1}{4}$, failed to show the beading, although most carefully constructed by Messrs. Powell and Lealand.

Experiments having been instituted on the nature of the errors, it was found that the instrument required a better distribution of

power,—instead of depending upon the deepest eyepieces and most powerful objectives hitherto constructed, that better effects could be produced by regulating a more gradual bending or refraction of the excentrical rays emanating from a brilliant microscopic origin of light.

It then appeared that delusive images, which the writer has ventured to name *eidōla**, exist in close proximity to the best focal point (where the least circle of confusion finds its locus), and :—

(I.) That these images, possessing extraordinary characters, exist principally above or below the best focal point, accordingly as the objective spherical aberration is positive or negative.

(II.) That test-images may be formed of a high order of delicacy and accurate portraiture in *miniature*, by employing an objective of twice the focal depth, or, rather, half the focal length of the observing-objective.

(III.) That such test-images (which may be obtained conveniently two thousand times less than a known original) are formed (under precautions) with a remarkable freedom from aberration, which appears to be reduced in the miniature to a *minimum*.

(IV.) The beauty or indistinctness with which they are displayed (especially on the immersion system) is a marvellous test of the correction of the observing objective, but an indifferent one of the image-forming objective used to produce the testing-miniature.

These results enable the observer to compare the known with the unknown. By observing a variety of brilliant images of known objects, as gauze, lace, an ivory thermometer, and sparkles of mercury, all formed in the focus of the objective to be tested with the microscope properly adjusted so that the axes of the two objectives may be coincident and their corrections suitably manipulated, it is practicable to compare known delusions with suspected phenomena.

It was then observed (by means of such appliances) that the aberration developed by high-power eyepieces and a lengthened tube followed a peculiar law.

A. A lengthened tube increased aberration faster than it gained power. (Roughly, the aberration varied as v^2, while the power varied as v.)

B. As the image was formed by the objective at points nearer to it than the *standard distance of nine inches*, for which the best English glasses are corrected, the writer found the aberration diminished faster than the power was lost by shortening the body of the instrument.

C. The aberration became negatively affected, and required a positive compensation.

D. Frequent consideration of the equations for aplanatism suggested the idea of searching the axis of the instrument for aplanatic foci, and that many such foci would probably be found to exist in proportion to the number of terms in the equations (involving curvatures and positions).

* From εἴδωλον, a false spectral image.

E. The law was then ascertained that power could be raised, and definition intensified, by positively correcting the searching-lenses in proportion as they approached the objective, at the same time applying a similar correction to the observing-objective.

The chief results hitherto obtained may be thus summarized.

The writer measured the distance gained by the aplanatic searcher whilst observing with a half-inch objective with a power of seven hundred diameters, and found it *two-tenths of an inch increase*; so that optical penetration was attainable with this high power through plate-glass nearly one quarter of an inch thick, whilst *visual* focal depth was proportionably increased.

The aplanatic searcher increases the power of the microscope from two and a half to five times the usual power obtained with a third or C eye-piece of one inch focal length. The eighth thus acquires the power of a twenty-fifth, the penetration of a one-fourth. And at the same time the lowest possible eyepiece (3-inch focus) is substituted for the deep eye-piece formed of minute lenses and guarded with a minutely perforated cap. The writer lately exhibited to Messrs. Powell and Lealand a brilliant definition, under a power of four thousand diameters, with their new "eighth immersion" lens, by means of the searcher and low eye-piece.

The traverse of the aplanatic searcher introduces remarkable chromatic corrections, displayed in the unexpected colouring developed in microscopic test-objects*.

The singular properties or, rather, phenomena shown by eidola, enable the practised observer in many cases to distinguish between true and delusive appearances, especially when aided by the aberrameter applied to the objective to display excentrical aberration by cutting off excentrical rays.

Eidola are symmetrically placed on each side of the best focal point, as ascertained by the aberrameter, when the compensations have attained a delicate balance of opposite corrections.

If the beading, for instance, of a test object exists in two contiguous parallel planes, the eidolon of one set is commingled with the true image of the other. But the upper or lower set may be separately displayed, either by depressing the eidolon of the lower stratum, or elevating the eidolon of the upper; for when the eidola of two contiguous strata are intermingled, correct definition is impossible so long as the aperture of the objective remains considerable.

One other result accrues: when an objective, otherwise excellent, cannot be further corrected, the component glasses being already closely screwed up together, a further correction can be applied by means of the adjustments of the aplanatic searcher itself, all of which are essentially conjugate with the actions of the objective and the variable positions of its component lenses; so that if δx be the traversing movements of the objective lenses, δv that of the searcher, F the focal distance of the image from the objective when δx va-

* Alluded to by Mr. Reade, F.R.S., in the 'Popular Science Review' for April 1870.

nishes, f the focal distance of the virtual image formed by the facet lenses of the objective,

$$\frac{\delta v}{\delta x}=-\left(\frac{F}{f_1}\right)^2.$$

The *appendix* refers to plates illustrating the mechanical arrangements for the discrimination of eidola and true images, and for traversing the lenses of the aplanatic searcher.

The plates also show the course of the optical pencils, spurious disks of residuary aberration and imperfect definition, as well as some examples of "high-power resolution" of the Podura and Lepisma beading, as well as the amount of amplification obtained by camera-lucida outline drawings of a given scale.

June 16, 1870.—General Sir Edward Sabine, K.C.B., President, in the Chair.

"Observations on the Mode of Growth of Discoid and Turbinated Shells." By Alexander Macalister, Professor of Zoology, University of Dublin.

A most interesting paper on the geometrical forms of turbinated and discoid shells was published by the Rev. Canon Moseley in the Philosophical Transactions for 1838, p. 351, in which some important points were noticed regarding the geometrical construction of shell-forms. The author of that paper describes discoid shells as generated by the revolution around a central point of the perimeter of a geometrical figure, which latter, although regularly increasing in size, yet remains always geometrically similar in form. The producing figure in many Gasteropodous Mollusks is represented by the operculum; and in all it may be recognized by making a vertical section in the plane of the radius vector. A turbinated shell is similarly generated; but the generating figure in the production of the helix slips down along the axis instead of revolving in a constant plane. The Rev. Mr. Moseley gives, as illustrations of these points, measurements of *Nautilus pompilius*, *Turbo phasianus*, *Turbo duplicatus*, and *Buccinum subulatum*, and describes many interesting particulars regarding the formation and growth of the operculum in different shells.

This subject does not seem to have attracted much attention from naturalists, as, with the exception of a notice in Professor Goodsir's lecture "On the Use of Mathematical Modes of Investigating Organic Forms"*, it is not, to my knowledge, referred to by any writer on zoology.

While engaged in arranging the large collection of shells in the Museum of the University of Dublin, I was led to make measurements of univalve shells in order to see whether any deduction of zoological importance might be drawn from these valuable geometrical observations, and more especially to determine whether it might be

* Goodsir's 'Anatomical Memoirs,' vol. ii. p. 209.

possible to arrive at constant specific numerical parameters in these cases; and in all instances I have been surprised by finding that, in well-formed shells, the ratios of the successive whorls have been specifically constant. In making these measurements, the points to be determined are three, viz.:—1st, the ratio of elongation of the radius vector of the spiral (k); 2nd, the degree of linear expansion of the generating figure in the successive whorls (m); and, 3rd, the degree of translation or slipping of the spiral on the central axis (n). The second of these we may call the discoidal coefficient, and the third the helicoidal coefficient.

On applying these measurements to univalve shells, we find that the possible combinations are five in number:—

1st, those in which $n=0$ and $m<k$,
2nd, those in which $n=0$ and $m=k$,
3rd, those in which $n=m$,
4th, those in which $n>m$,
5th, those in which $n<m$.

The cases of discoid shells in which $n=0$ are two, the first and second on the list. The first and most uncommon is that in which the amount of elongation of the radius vector in the formation of the successive whorls exceeds the transverse linear increase of the producing figure. The resulting form of this case (which may be formulated thus, $k>m$) is an open spiral, as in the fossil Gasteropodous genus *Eccyliomphalus*, or the Cephalopodous genera *Gyroceras*, *Nautiloceras*, and *Spirula*. The common species of this last genus gives the following measurements:—

Spirula prototypus, $m=2{\cdot}6$, $k=3{\cdot}3$, $n=0$. Generating figure, a circle. Average width of whorls 0·075 in., 0·2 in.*

It will be noted that all these spirals are true logarithmic curves; and hence the widths of the whorls measured on the radius vector will form a series of numbers in geometrical progression, the common ratio of the progression being, in discoid shells of the second group (where $m=k$), equal to the coefficient of linear increase of the generating figure. To verify the coefficients deduced from the numbers obtained by measurement, I have used the method given by the Rev. Canon Moseley, which depends upon a well-ascertained property of the logarithmic spiral, that if μ be taken to represent the ratio of the sum of the lengths of an even number (m) of the whorls to the lengths of half that number, then $k=(\mu-1)\frac{2}{m}$. Applying this formula to the cases given below, I have in the majority of cases ob-

* In all the specimens measured and referred to in this paper, I have made at least three measurements of each individual; and in the majority of cases I have measured at least six specimens of each species. These measurements are in decimal parts of an English inch, and were made with a finely pointed pair of compasses and a diagonal scale, the eye being in some cases aided by a magnifying-glass. Some specimens were measured by means of sections made in a plane perpendicular to the axis.

tained results which confirm the ratios of the series of measurements otherwise obtained.

The second case of discoid shells, in which $m=k$ and $n=0$, is by far the commoner, as to it belong all genera of discoidal mollusks, with the few exceptions noticed above. The case $m > k$ is one which cannot occur, as then the outer whorl must necessarily crush the inner, and then the generating figure could not retain its geometrical identity while enlarging; hence we find no examples of it in discoid shells.

I have placed in this second case some instances in which the ratio of slipping or translation on the axis is not easily measured, and virtually amounted to nothing.

The following Table of examples illustrate case No. 2:—

Species.	$n=0$, $k=m$.	Generating figure.	Width of whorls in decimals of an inch.							
Haliotis viridis	10	Ellipse	0·075 0·05 0·15	0·75 0·5 1·5						
Haliotis rugoso-plicata	9·3	,, ...	0·02 0·03	0·18 0·28	1·6 2·7					
Sulculus (Haliotis) parvus	6	Oval	0·03	0·17	1					
Padollus (Haliotis) excavatus	4·2	Ellipse	0·06	0·25	1·1					
Natica canrena	3	Segment of circle....	0·025	0·075	0·25	0·76				
Nautilus pompilius	3	Segment of ellipsoid..	0·2265	0·68	2·04					
Dolium zonatum	2·1	......	0·119	0·25	0·525					
Solaropsis pellis-serpentis	2	......	0·023	0·047	0·086	0·17	0·34			
Planorbis corneus	2	Segment of circle	0·02	0·04	0·08	0·172				
Euomphalus pentangulatus	2	......	0·124	0·25	0·48					
Architectonica magnifica	1·75	Rhomboid ..	0·07	0·12	0·2	0·35	0·65			
Architectonica trochleare	1·62	,, ...	0·046	0·075	0·175	0·2	0·325	0·55		
Conus betulinus	1·43	Triangle	0·02	0·03	0·05	0·072	0·09	0·12	0·17	0·25
Conus literatus	1·4	,, ...	0·03	0·04	0·05	0·86	0·125	0·176	0·25	
Conus virgo	1·25	,, ...	0·08	0·1	0·105	0·16				
Planorbis, sp.	1·38	......	0·03	0·042	0·053	0·078	0·1	0·15	0·18	

Hitherto we have been examining the formulæ for discoid shells; but by far the greater number of shell-forms are those in which the whorls, instead of remaining in the same plane, slide down on the central axis, thus making a turbinated shell-form. A new principle enters into our calculation here; for the shape of a turbinated shell depends on the mutual relation of three, and not two constants. These are:—first, the form of the generating figure; secondly, the discoidal coefficient, m; thirdly, the helicoidal coefficient, n. Upon the relations of these parameters to each other depends the shape of the shell. Thus in some n is nearly equal to m, and in such cases the whorls scarcely embrace each other, and the figure produced is that of an elongated cone, as in the genera *Turritella*, *Cerithium*, *Acus*, &c. Sometimes n exceeds m; and in this case the resulting form is an open spiral as in *Vermetus*, or a rapidly descending series of whorls. A third possible case is that in which n is less than m, and the resulting figure is globular; but of this case, though a possible one, I have not as yet succeeded in obtaining an example.

The following cases illustrate the formula $n > m$:—

	n.	m.	Width of whorls in decimals of an inch.				Amount of translation.			
Vermetus lumbricalis ..	1·42	1·3	0·075	0·1	0·13	0·175	0·15	0·22	0·3	0·45
Delphinula atrata	6·00	2·85	0·018	0·5	0·148	0·41	0 01	0·65	0·3	

The following instances exemplify the case $n=m$:—

Species.	$n=m$.	Length of whorls in decimals of an inch.											
Helicostyla polychroa....	2	0·41	0·081	0·158	0·32	0·7							
Fusus colosseus	1·71	0 09	0·14	0·26	0·43	0·76							
Phasianella bulimoides ..	1·8	0 07	0·125	0·23	0·45								
Scalaria preciosa........	1·56	0·05	0·078	0·13	0·2	0·32	0·52						
Fusus antiquus	1·5	0·15	0 225	0·343	0·54	0·84							
Mitra episcopalis	1·434	0·245	0·4	0·575	0·82								
Trochus niloticus	1·41	0·2	0·3	0·425	0·63	0·9	1·2						
Fusus longissimus	1·341	0·25	0·3	0·44	0·6	0·81							
Fusus colus	1·33	0·15	0·2	0·26	0·35	0·42	0·54	0·83					
Pyrazus sulcatus	1·38	0·13	0·17	0·29	0·38	0·51							
Acus dimidiata	1·277	0·2	0·267	0 31	0·4	0·52	0·62	0·88					
Acus maculata..........	1·25	0·15	0·176	0·23	0·29	0·37	0·45	0·53	0·7	0·9			
Acus crenulata	1·25	0·2	0·25	0 32	0·38	0·496	0·6						
Cerithium nodulosum ..	1·24	0·23	0·3	0·37									
Pirena terebralis	1·23	0·08	0·12	0·15	0·178	0·22	0·28	0·35					
Pyrazus palustris	1·22	0 15	0·182	0·22	0·27	0·34	0 42	0·5					
Zaria duplicata	1·23	0·078	0·1	0·125	0·16	0·2	0·24	0·3	0·26	0·44	0·53	0·625	0·75
Acus subulata	1·163	0·175	0·2	0·23	0·265	0·32	0·367	0·432	0·47	0·641			
Telescopium fuscum....	1·14	0·1	0·112	0·125	0·15	0·18	0·2	0·24	0·28	0·325	0·365		

MISCELLANEOUS.

On Phacochœrus? *or* Sus? Sclateri. By Dr. J. E. Gray, F.R.S.

In the last Number of the 'Annals,' p. 190, I remarked that the *P. Æliani* figured by Mr. Sclater "is only a usual form of the female African wart-hog." I no sooner saw this in print than I felt I had made a mistake; for I then recollected that I never had observed such a difference between the two sexes of that animal; and we have in the British Museum the skull of a female wart-hog which we received from the Zoological Society, along with her male companion, which has the broad nose and the large conical diverging canines well developed, just as in the males, but not quite so large. I inquired of Mr. Bartlett what was the difference between "the fine pair of Ethiopian wart-hogs from Natal, now in the Gardens?" and he informed me that they were very much alike in general appearance, and chiefly to be distinguished by their sexual organs; so that if *P. Æliani*, Sclater (*P. Sclateri*, Gray), is a *Phacochœrus* (I say this advisedly, for I had doubts on the subject when I first looked at the plate and woodcut), it must be a very young undeveloped female, and scarcely a fit subject for the description of a species. It has no appearance of the wide hippopotamus-like mouth so characteristic of the wart-hogs; but I could not bring myself to believe that Mr. Sclater, so long the Secretary of the Zoological Society, and with so many opportunities of studying these animals, and who seems to have made this genus his especial study, did not know a

wart-hog (*Phacochœrus*), with complicated teeth like the elephant, from a pig (*Sus*), with simple ones, and therefore regarded that as a settled point. My infirmities not allowing me to go beyond the walls of the Museum, I must leave this question to be settled by those who can examine the animal. Can it be the female of the wild boar of Kordofan and Soudan, called "Quadruk" by the Arabs, or of the wild boar seen by Dr. Murie in Africa? See 'Catalogue of Carnivorous and Pachydermatous Mammalia in the British Museum,' p. 338.

On the Circulation of the Oligochæta of the Nais-*group.* By M. E. Perrier.

In his anatomical investigation of the Oligochætal Annelides, M. Claparède entirely passed over the *Nais*-group; and no important work has since been published upon those animals. A tolerably extensive investigation of *Dero obtusa*, an animal nearly allied to *Nais*, enables us to make known some new facts as to the circulatory apparatus of those animals, which has not hitherto been studied.

Dero scarcely differs from *Nais* except by its possession of a branchial apparatus composed of four simple retractile digitations inserted upon a sort of lobe (*pavillon*), which spreads out at the posterior extremity of the body, and of which a figure, incorrect in some respects, has been given by D'Udekem in the 'Bulletins de l'Académie Royale de Belgique.'

The circulatory apparatus of *Dero obtusa* consists essentially of a ventral and a dorsal vessel, both lying in the median line. The dorsal vessel is contractile. These two principal trunks are united in a very complex manner, which must be studied in the head, in the anterior segments, the middle segments, and the caudal respiratory apparatus.

In the five segments which follow the head the two median vessels are united by an infinity of lateral branches, forming a very complicated network, which surrounds the buccal apparatus and the œsophagus; these two vessels are considerably diminished when they reach the cephalic region. Beneath the mouth the ventral vessel emits two branches, which penetrate into the cephalic cavity; the dorsal vessel is prolonged above the brain to the anterior extremity of the cephalic cavity, and then it divides into two branches, which bend back on each side and become again subdivided; into these the two branches of the ventral vessel open.

In segments 6, 7, and 8, there are three contractile hearts, each formed by two floating, perivisceral, vascular loops.

In the middle segments three or four vascular rings originate from the dorsal vessel and embrace the intestine very closely; they surround this without communicating with the ventral vessel. These rings are united by a great number of longitudinal vessels, placed at regular intervals, and forming with the rings a very elegant trellis with rectangular openings. Small vessels originate from this trellis, and divide upon the surface of the intestine. From one of the

longitudinal vessels, situated near the plane of horizontal symmetry of the intestine, springs a vascular branch, which sometimes bifurcates and opens into the ventral vessel, so that the blood starting from the dorsal vessel is obliged to traverse the whole network before entering the ventral vessel.

These arrangements are partly masked by the hepatic cells in the living animal. They seem to indicate that the intestine of the *Naïdes,* which is clothed with vibratile cilia, plays an important part in respiration.

The ventral vessel is prolonged to the posterior extremity of the caudal lobe. There it bifurcates, giving origin to two branches, which run along the margins of the triangular lobe, cutting off at its lateral angles two equilateral triangles. From each of these branches, opposite to each respiratory digitation, springs a branchlet which penetrates to the apex of the digitation, where it is recurved in a loop, and is then connected with the vascular loop of the digitation of the same side. From this two lateral vessels are produced, which unite with the prolongation of the two parent branches to form the dorsal vessel.

Suppressing the special contrivance of the respiratory lobe of *Dero* we arrive at the type of the vascular apparatus of *Nais* proper.—*Comptes Rendus,* June 6, 1870, tome lxx. pp. 1226–1228.

Observations on the Natural History of the Crayfish. By M. Chantran.

Copulation.—The copulation of the crayfish takes place during a period which includes the months of November, December, and January. The male seizes the female with his large nippers, turns her over, and whilst he holds her lying on her back, places himself in such a manner as to pour out the fecundating material upon the two outer lamellæ of the tail. After this first operation, which lasts some minutes, he conveys her rapidly beneath his abdomen in order to effect a second deposition of semen upon the plastron round the external opening of the oviducts, by means of the curious mechanism so accurately described by M. Coste.

Oviposition.—According to the degree of maturity of the ova at the time of the union of the sexes, oviposition takes place at a period varying from two to forty-five days after copulation. At the moment when this function is about to be performed, the female lies upon her back and brings up her tail upon her plastron, in such a manner as to form with her abdomen a chamber enclosing the aperture of the oviducts, and the wall of which secretes a viscous fluid intended to fasten the eggs to the abdominal appendages during incubation. When things are in this state, the laying of the eggs takes place. It is effected at once, usually during the night, rarely during the day. Incubation lasts about six months; and the hatching takes place in May, June, or July.

Moults.—The first moult takes place ten days after exclusion; the second, third, fourth, and fifth at intervals of from twenty to

twenty-five days; so that the young animal changes its carapace *five times* in from ninety to one hundred days, corresponding to the months of July, August, and September. From the end of this last month until the end of April in the following year there is no change.

The sixth moult takes place in May, the seventh in June, and the eighth in July. There are consequently *eight* moults in the first twelve months of the life of the young crayfish.

In the second year there are five moults:—the first and second in August and September; the third, fourth, and fifth in May, June, and July.

In the third year I have observed only two moults, of which the first takes place in July and the second in September. From this time the young crayfish becomes adult, on entering upon its fourth year.

When the crayfish are adult, moulting takes place only once a year in the females; it occurs, however, twice in the males, which explains why the latter are larger than the females, the growth being in proportion to the number of moults. In the adult males the first moult takes place in June and July, and the second in August or September. The single moult of the females occurs in August or September.

To effect its moult, the animal places itself on its side; with its head and back it raises its carapace, which swings like a lid upon its hinge; then, when it has thus completely disengaged the anterior part of its body, it separates entirely from its old carapace by a sudden movement of the posterior part. This operation, which lasts about ten minutes, is favoured by the previous secretion of a gelatinous material between the two carapaces, which facilitates their disengagement.

Twelve hours after the moult the legs of the crayfish are already sufficiently firm to pinch strongly; twenty-four hours afterwards they are completely hardened. The walls of the back remain longer flexible; but at the end of forty-eight hours they have attained nearly a normal degree of consistency.

The young animals remain attached to the false legs of the mother for ten days after exclusion, when the first moult takes place; this is effected actually under the tail of the mother*. If the young detach themselves before this period, they cannot live separately; but after this first moult they sometimes quit their mother and return to her again, up to the twentieth day, at which period they can live independently.

* *Note by M. C. Robin.*—I have ascertained, by means of the microscope, as shown by M. Chantran to the Academy, that the young remain suspended beneath the abdomen of the mother by means of a hyaline *chitinous* filament, which extends from a point of the inner surface of the egg-shell to the four most internal filaments of each of the lobes of the median membranous lamina of the caudal appendage. This filament exists when the embryos have only attained about three fourths of their development before exclusion.

I am inclined to think that after their first moult the young crayfish feed, beneath the tail of their mother, upon the pellicles of the eggs and the carapace thrown off in this first moult; but I am waiting for further observations before asserting this positively.—*Comptes Rendus*, July 4, 1870, tome lxxi. pp. 42–45.

The Brachiopoda *a Division of* Annelida. By Edward S. Morse.

At a meeting of the Boston Society of Natural History, June 1st, 1870, Mr. Edward S. Morse made a verbal communication on the position of the Brachiopoda in the animal kingdom. He referred to the branch of Mollusca as it was understood forty years ago, when, misled by external characters, many worms, like *Serpula* and *Spirorbis*, and a group of crustaceans, the Cirripedia, were included with mollusks, and remarked that, from a proper recognition of their characters, these diverse forms had been eliminated from time to time, and referred to their proper branches. After long and careful study, Mr. Morse was prepared to state that the Brachiopods were true Articulates, and not Mollusks, and that their proper place was among the worms, forming a group near the tubicolous Annelids.

He stated that for the past year he had been deeply engaged in the study of the Brachiopoda, and more particularly their early stages. Besides material from the coast of New England, he had had, through the kindness of Prof. A. E. Verrill, a large lot of *Discina* from Callao, Peru, belonging to the Yale College Museum. From these he had studied their early stages; but as he had in preparation a memoir upon the subject, he would now confine himself to the considerations that follow.

He first spoke of the structure and composition of the Brachiopod shell, and pointed out the relations between the cæcal prolongations of the mantle in *Terebratula* and a similar structure in the test of Crustacea. He had also noticed a marked resemblance between the polygonal cells in the shell of a young *Discina* and a similar feature in certain lower crustaceans. The scale-like structure of the test of *Idotæa* resembled the scale-like structure in *Lingula*. The skin of *Nereis* had similar punctures or dots, as seen in *Terebratula* and also in the peduncle of *Lingula*. He had submitted the shell of *Discina* to chemical tests, and believed it to be chitinous. Gratiolet had already given the chemical analysis of *Lingula anatina*, and found forty-two per cent. of phosphate of lime, and only six per cent. of carbonate of lime. The position of the valves of all Brachiopoda were dorsal and ventral; and this was a strong articulate character, to be compared to the dorsal and ventral plates of the Articulates. The horny setæ that fringe the mantle of Brachiopods was a feature entirely absent in the Mollusca, and peculiar to the worms.

The bristles of worms differ from those of other articulate animals in having sheaths containing muscular fibre, while in other Articulates the hairs were simply tubular prolongations of the epidermal

layer. In Brachiopods the setæ or bristles were secreted by follicles imbedded in or surrounded by muscular fibres, and were moved freely by the animal. In the structure of the setæ he found an identity with that of the worms. He then called attention to the resemblance between the lophophore of the Brachiopods and a similar structure in the tubicolous worms. In *Sabella* the cephalic collar was split laterally, and a portion of it reflected. Let this collar be developed so as to cover the fringed arms, and a representation of the mantle of Brachiopoda would be attained. The thin and muscular visceral walls suggest similar parts in the worms. The circulating system he had not sufficiently studied, though Dr. Gratiolet had stated that in this respect there was a strong resemblance to the Crustacea.

In regard to the respiratory system, Burmeister had shown that there was a resemblance between the soft folds or lamellæ developed on the internal surface of the mantle of *Balanidæ* and similar features in *Lingula*; though the existence of these folds in *Lingula* had been questioned, he would presently show that Vogt was right in his observations. In regard to the reproductive system, he called attention to the fact that in one group of Cirripeds the ovaries were lodged in the upper surface of the peduncle, while in another group the same parts were lodged in the mantle. A similar condition existed in the Brachiopods, where in one group the mantle holds the ovaries, while in another group they are found in the visceral cavity.

Through Polyzoa, also, he showed that, in their winter eggs or statoblasts, a relation was seen to the ephippia of *Daphniæ*, and the winter eggs of Rotifers.

Of great importance also, and upon which he laid particular weight, were the peculiar oviducts with their trumpet-shaped openings, so unlike the oviducts of mollusks, and, as he believed, bearing the closest affinity to the oviducts in many of the worms,—namely, a pair of tubes, and in one case two pairs, having their inner apertures with flaring mouths, suspended in the visceral cavity, thus opening a direct communication between the visceral fluids and the surrounding media. He then called attention to what little information we had regarding the embryology of the Brachiopods. Lacaze-Duthiers had shown that in *Thecidium* the embryo was composed of four segments with eye-spots and other strong Articulate features. Fritz Müller had given a description, with figures, of the early stage of *Discina*, in which we have not only little cirri projecting from the shell, but a little appendage recalling the plug or operculum in some of the tubiculous worms.

Of great importance, also, was the fact that in the early stage of *Discina*, Müller observed large bristles, and these were moved freely by the animal. Smitt had shown that in certain Polyzoa (*Lepralia*) the embryo, besides being furnished with cilia, also supported several bristles or setæ, which were locomotive; and, finally, in the worms, Claparède and Mecznikow had figured an embryo of *Nerine* in which barbed bristles were also developed. Mr. Morse referred to his communication before the American Association for the Advancement of

Science on the early stages of the Brachiopods, in which he had shown the intimate connexions existing between this group and the Polyzoa. Now Leuckart had already seen reasons for placing the Polyzoa with the Annelids; and he would call attention to *Crepina gracilis* and *Phoronis hippocrepia* (admitted to be worms, or early stages of them), and their close resemblance in nearly every point of their structure to the hippocrepian Polyzoa. Mr. Morse then stated that in the evidence already given he had drawn his conclusions from alcoholic specimens of *Terebratula* and *Discina*, and from the papers of Lacaze-Duthiers, Claparède, Mecznikow, Hancock, Huxley, Vogt, Hyatt, Williams, De Morgan, and others. He felt the importance of first examining *Lingula* in a living condition before making these announcements; and for this reason he had recently visited the coast of North Carolina for the express purpose of finding, if possible, the rare *Lingula pyramidata* of Stimpson, first discovered by Prof. Agassiz in South Carolina. After nearly a week's fruitless search, he had found it, had studied it alive, and had brought with him living examples, which he had the pleasure of exhibiting before the Society.

He would here express his deep sense of gratitude to Dr. Elliott Coues, Surgeon U.S.A. at Fort Macon, N.C., and to the Commandant of the Post, Major Joseph Stewart, U.S.A., for the constant aid and sympathy rendered to Dr. A. S. Packard and himself during their visit there. He would not enter into a description of *Lingula*, as he had already in preparation a memoir upon the subject, but would call attention simply to the additional evidence in support of the views advanced.

Lingula was found in a sand-shoal at low-water mark, buried just below the surface of the sand. The peduncle was six times the length of the shell, and was encased in a *sand-tube* differing in no respect from the sand-tubes of neighbouring Annelids. In many instances the peduncle was broken in sifting them from the sand, yet the wound was quickly repaired, and another sand-case was formed.

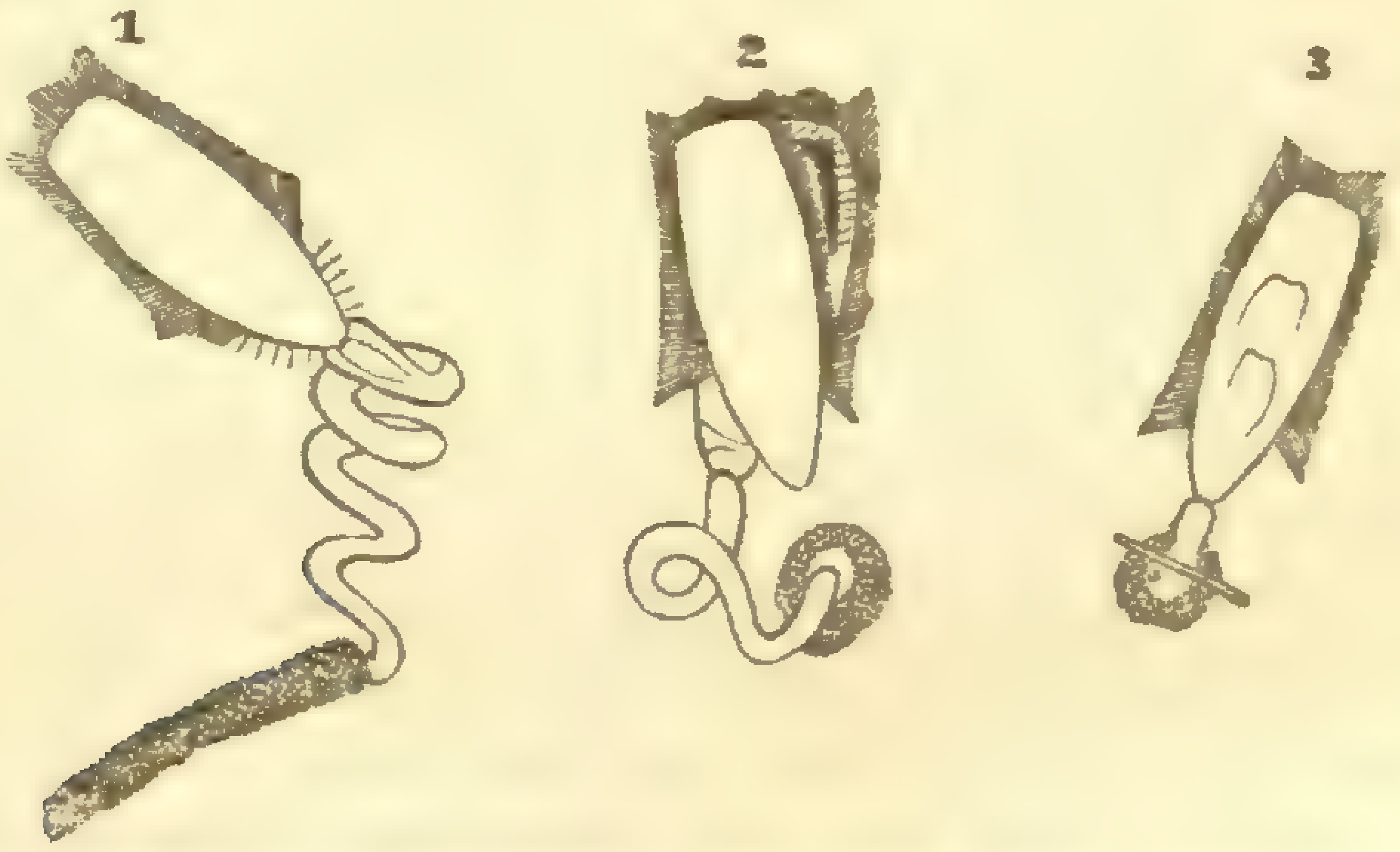


Fig. 1. Peduncle perfect, retaining portion of sand-tube.

Fig. 2. Showing valves in motion; peduncle broken and forming new sand-case.

Fig. 3. Peduncle broken close to the body, and forming new sand-case.

He observed that *Lingula* had the power of moving over the sand by the sliding motion of the two valves, using at the same time the fringes of setæ, which swung promptly back and forth like a galley of oars, leaving a peculiar track in the sand. In the motion of the setæ he noticed the impulse commencing from behind and running forward.

Within the mantle he found a series of rows of prominent lamellæ in which the blood rapidly circulated—thus confirming the correctness of Vogt's observations. These lamellæ, however, were contractile.

The peduncle was hollow, and the blood could be seen coursing back and forth in its channel. It was distinctly and regularly constricted or ringed, and presented a remarkably worm-like appearance; it had layers of circular and longitudinal muscular fibre, and coiled itself in numerous folds, or unwound at full length; it was contractile also, and would quickly jerk the body beneath the sand. But the most startling observation in connexion with this interesting animal was the fact that its blood was *red*. This was strongly marked in the gills and various ramifications of the mantle, and in the peduncle. At times the peduncle would become congested; and then a deep rose blush was markedly distinct. Mr. Morse expressed his gratification in having come to the conclusions in regard to the annelidan characters of Brachiopods a long time previous to his observations on *Lingula*.

He then concluded by stating that the Brachiopods, with the Polyzoa, should be removed from the Mollusca, and placed with the Articulates among the Annelids; that the Brachiopods came near the tubiculous worms, though they were much more highly cephalized; that they exhibit certain Crustacean characters, but were widely removed from the Mollusca, unless a relation could be traced through the homologues of the Polyzoa to that aberrant group, the Tunicates, as pointed out by Allman. He believed the Brachiopods to be a comprehensive type, exhibiting general Articulate features, and forming another example of those groups belonging to the last that exhibit the characters of two or more classes combined.

It was interesting in this connexion to remark that *Lingula*, one of the earliest forms created, had yet remained the same through all ages of the earth's history.—*Silliman's American Journal*, July 1870.

Our two Swallows and their Nests. By M. J. B. Noulet.

M. Noulet, writing from the neighbourhood of Toulouse, states that the two species of swallows (*Hirundo rustica* and *H. urbica*) have not made any alteration in their mode of architecture such as has lately been described by M. Pouchet.

The first species, *H. rustica*, our chimney-swallow, and the *Hiroundélo* of Languedoc, builds a nest which is broadly open like a balcony in all its free part; and the young birds which occupy it show their heads all round the opening, especially when expecting the return of their parents. The nest of *H. urbica*, on the contrary,

is of greater depth, and has a small circular opening. This is what M. Pouchet calls the old mode of building; and M. Noulet declares that it is still followed by the house-martins of his district. His opinion is that Spallanzani's opinion, disputed by M. Pouchet, is confirmed,—namely, "that every species constructs its nest upon a model which is peculiar to it, which never changes, and is perpetuated from age to age."—*Comptes Rendus*, July 4, 1870, pp. 79–81.

On the Scissiparous Reproduction of the Naidina. By M. E. Perrier.

The investigations upon the scissiparity of the *Naides* and allied Oligochæta at present relate only to *Nais proboscidea*. Gruithuisen, O. F. Müller, Leuckart, and Max Schultze have successively studied this phenomenon. Their views, although distinct in some respects, may nevertheless be fundamentally reduced to the following statement.

The *Naides* alternately present two modes of agamic generation: one individual *divides* at first into two others of equal length; then each of the individuals thus formed produces a new one at its hinder part by a process of *gemmation*.

The observations that we have made upon *Dero obtusa* enable us to present the mode of reproduction of the *Naides* under another aspect.

Whilst in *Nais proboscidea* chains of three or four individuals are frequently met with, in *Dero obtusa* we have never seen more than two individuals placed end to end. The head of the hinder individual and the tail of the anterior one are formed, however, precisely as indicated by Max Schultze in his *Nais*. These two individuals separate before we observe in them any trace of fresh scissiparity; but in front of the respiratory lobe which terminates the body we always see, *so long as the individual is not adult*, numerous animals in course of formation, and in which we may follow the development of the setigerous sacs, the segmental organs, the muscles, &c. When the two separated individuals have attained a sufficient length, the median scissiparity recommences in them, as in the single individual at the cost of which they were formed.

Now, as this phenomenon is only produced when the animal has attained a certain length, it follows that the hinder individual of the second generation will be formed of segments which were not developed until after the separation of the individual, but formed *an integral part of that individual when they were produced*.

Thus the *Dero* first enlarges by the formation of segments in front of its vibratile lobe, and then undergoes *scissiparous division*.

This being settled, suppose that the two *Deros* of the first generation were not separated after their individualization, then the individuals of the second generation would have been produced between the vibratile lobe and the rest of the body of each of the individuals of the first generation. Moreover each of these new individuals would have been formed by means of segments originating after the individualization of the two primary *Deros*, as we have explained.

But we then fall back upon the law developed by Max Schultze for *Nais proboscidea.* We fall back upon it without implying any other generation than that constituting the normal and continuous mode of growth of the Annelide in question. We therefore think that we may express the opinion that in the *Naides* there are not two modes of agamic reproduction, one by scissiparity, the other by gemmation. There is nothing but *scissiparity.*

The gemmation observed by the authors who have already treated this question appears to us to be nothing but the normal phenomenon of growth of the individual. Hence we no longer meet with it in the posterior portion of the body of adult individuals. It is only when it has brought each individual produced by scissiparity to a certain size that a new division takes place. This fresh division may appear before or after the complete separation of the primary individuals. This, according to us, is the sole difference.—*Comptes Rendus,* June 13, 1870, p. 1304.

On Edible Bull-frogs.

"*Bull-frogs* are eaten in Philadelphia. I saw laid out on the counter an edible which somewhat resembled a fried sole. I observed several persons devouring them greedily, and. on inquiring what they were, learned to my extreme horror that they were *bull-frogs,* gutted, slit open, and fried in eggs and bread-crumbs. They are also to be had at railway-stations."—*H. Phillips, Musical and Personal Recollections,* 1864, p. 122.

Note on a new Genus of Sponge from West Australia. By Dr. J. E. Gray, F.R.S. &c.

Echinospongia.

Sponge very hard, woody, erect, dividing above into elongate, virgate, erect branches, with three or four more or less subspiral series of large angular lobes, much broader than the central stem. Outer bark of the stem and lobes porous, and more friable than the central axis. Surface smooth, without any appearance of pores or of oscules when dry; substance strengthened with numerous slender elongate fusiform spicules and minute six-rayed cubical stars, rays cylindrical and strongly dentate at the end.

Echinospongia australis.

Hab. Nichol's Bay, West Australia.

This remarkable Sponge was discovered by Mr. Clifton, who has kindly sent a specimen to the British Museum.

Dr. Bowerbank has figured the spicules of a reticulated Sponge from the same locality, which I have called *Axos Cliftoni*; but in it the spicules are formed of two flat three-rayed stars, placed one on the other so that the rays alternate; they are similarly dentate at their extremity.

THE ANNALS

AND

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[FOURTH SERIES.]

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XXVI.—*The Ostracoda and Foraminifera of Tidal Rivers.* By GEORGE STEWARDSON BRADY, C.M.Z.S., and DAVID ROBERTSON, F.G.S. *With an Analysis and Descriptions of the Foraminifera*, by HENRY B. BRADY, F.L.S.

[Plates XI. & XII.]

Part II.

THE Rhizopoda inhabiting brackish water are interesting alike in their zoological and physiological aspects. The marine species belonging to these lower types of animal life are well known so far as concerns the British seas, and their mutual relationships have been thoroughly studied; the freshwater fauna of corresponding organization has also received careful attention at the hands of able naturalists; but researches on the two subjects have been prosecuted in a great measure without reference to each other, and our knowledge of the intermediate fauna is consequently fragmentary and of limited value for purposes of comparison.

The results detailed in the present paper have no claim to be regarded as an exhaustive treatment of the subject, but are offered rather as another instalment towards the history of an interesting phase of animal existence.

The structure of the investment of the sarcode body of the Rhizopoda, and its chemical and physical characters, have been regarded as forming the most reliable basis for classification; but how much the nature of the carapace depends upon mere external circumstances has already been shown, with respect to the Difflugian group, by Dr. Wallich; and there can be little doubt the same views are equally applicable to some genera of the order Reticularia. Hence a few preliminary remarks may not inaptly be devoted to general consider-

ations respecting the relation of the marine Rhizopod fauna of our coast to that of its adjacent brackish waters, first, with respect to distribution, and, secondly, with regard to modifications in the external characters of species common to both, due to altered conditions of life.

A comparison of the Table of Brackish Foraminifera with the complete list of species known to inhabit the British seas will show that the number of types or subtypes that entirely refuse to accommodate themselves to brackish conditions in one or more of their varietal developments is exceedingly small. Out of the forty-four reputed genera constituting the British marine fauna, representatives of thirty-two appear in the table, the following only being absent, viz.:—*Hauerina*, *Saccammina*, *Valvulina*, *Lingulina*, *Spirillina*, *Bigenerina*, *Cassidulina*, *Anomalina*, *Tinoporus*, *Nubecularia*, *Operculina*, and *Nummulina*. Specimens closely resembling *Saccammina* and *Tinoporus* have been noticed in our brackish gatherings; but, as their identification is not beyond dispute, they have been excluded from the list. *Hauerina*, *Lingulina*, and *Nubecularia** are of extreme rarity in our seas; the occurrence of living specimens of *Nummulina* is still ground of debate; and the remaining six genera are either somewhat local in their distribution or affect our deeper waters only. It should be noted that *Glandulina* has no claim to a place in the Table, except on the ground of a solitary specimen from the Scheldt.

Passing from entirely absent types to those whose presence may be regarded as accidental (such as are represented by one or two examples only, usually of stunted growth and confined to a single locality), seven other genera may be set aside as not "proper" to brackish water, viz. *Nodosaria*, *Vaginulina*, *Marginulina*, *Uvigerina*, *Orbulina*, *Virgulina*, and *Pulvinulina*. As the two first named are very common indeed on many portions of the coast at no great distance from brackish areas which have been searched, their non-appearance can only be explained on the ground that they do not survive any material decrease in the proportion of saline constituents in their native element; and this is doubtless true of all seven.

Cornuspira, *Cristellaria*, *Polymorphina*, *Globigerina*, *Textularia*, and *Patellina* show greater adaptive power; but the invariable smallness and delicacy of their shells, and their presence in those localities only which are least removed from the direct influence of the sea, indicate that, though still surviving, the admixture of even small proportions of fresh water

* *Nubecularia* has not hitherto been recorded from a British locality; but I have specimens of *N. lucifuga* from deep water in Mounts Bay, Cornwall.—H. B. B.

has an essentially deteriorating influence. The same remark is nearly equally true of the Textularian genera. On the other hand, the genus *Lagena* occurs in great abundance and variety amongst the microzoa of the less brackish gatherings, especially in those taken from muddy bottoms, though never found where the influx of fresh water is excessive. The specimens are of average size, fully developed, and have well-marked characters; indeed the genus appears to flourish in such situations. *Bulimina*, represented almost exclusively by *B. ovata*, *Planorbulina*, by *P. mediterranensis*, and *Discorbina*, by *D. globularis* and *D. rosacea*, are also common under similar conditions.

Lastly, we find a number of genera which flourish in water of varying degrees of density, from that of the more nearly marine localities to which allusion has just been made, to that of pools which at times contain only traces of saline matter. The most conspicuous are the Milioline genera (notably *Quinqueloculina*), *Trochammina*, *Lituola*, *Truncatulina*, *Rotalia*, *Polystomella*, and *Nonionina*. These genera are usually associated under such circumstances with Rhizopoda of the Difflugian type—the latter increasing in number as the Foraminifera diminish, until, in fresh water, the *Difflugiæ* and their immediate allies become the representatives of the testaceous group.

Specimens of two species of Foraminifera (*Polystomella striatopunctata* and *Nonionina depressula*), to all appearance living and associated with other living microzoa, however, have been found in fresh water. The locality was a freshwater lough about five miles south of Westport in Ireland. These are doubtless the survivors of a prehistoric brackish fauna; and their existence is not altogether surprising when we know that in some scarcely brackish situations far removed from the sea (for instance, the upper pools in Hylton Dene) the same species are or, rather, in this case *were*, before the tract was drained, present in abundance.

The Foraminifera of the Fen area are somewhat anomalous in their distribution, and require separate notice. We have the means, rarely attainable, of comparing them with their immediate predecessors in point of time. In many parts of the district there is to be found immediately underlying the peat a bed of clay which, at some distant period (scarcely distant enough to rank in geological time), formed the muddy bottom of the brackish or almost marine expanse of water. The microzoa of this subrecent deposit have been thoroughly investigated by Messrs. Parker and Jones; and the results, collected from four different localities, are tabulated in an elaborate memoir, published a few years ago in the 'Philosophical

Transactions' (vol. clv. p. 422). These go far to explain the peculiarities of the living fauna of the same area. In most of our brackish localities the living species are presumably the offspring of specimens which have been washed in and gradually acclimatized; but in the Fens the present Rhizopod fauna must consist in great measure of the direct representatives of those which flourished under the earlier more nearly marine conditions; and hence, with some allowance for possible change of climate, the relation of the living to the subrecent fauna is one which has been determined by gradual alteration in the physical aspects of the country, of which the chief result, so far as affects animal life, has been the lessened proportion of saline constituents in the water. The following genera, which were living in the Fens at this earlier era, have now totally disappeared, viz.:—*Cornuspira*, *Nodosaria*, *Uvigerina*, *Spirillina*, *Textularia*, *Virgulina*, *Bolivina*, *Pulvinulina*, *Discorbina*, and *Patellina*; and it is a noteworthy argument against the probability of any material change in climate that the whole of these, except *Spirillina*, still live in brackish water at portions of our coast nearer the open sea than the Fens now are. On the other hand, no single new genus has appeared during the period, if we except a straggling specimen or two of *Biloculina*. The *Miliolæ* generally have become commoner, whilst the whole family of the *Lagenida* have diminished in numbers; but, with these exceptions and the disappearance of the types above enumerated, there is a striking agreement between the present and past Rhizopoda of the Fen area. Our analysis need not extend to details respecting species, which may be gathered from the Table, further than to note that, out of forty-one specific and varietal forms found subfossilized in the clay, twenty have survived the changes alluded to, and the few new forms which now exist generally represent depauperated conditions of certain of the older types.

A comparison of specimens derived from marine and brackish sources, in species common to both, has considerable bearing on the connexion between the various groups of Rhizopoda. The effect of change of habitat is more marked in some genera than in others; but it may be generally stated that as the proportion of salines in the water decreases, the tests of the Foraminifera show a corresponding deficiency in calcareous matter.

In the *Miliolida* the deficiency is sometimes evidenced merely by the diminished thickness of the shell-wall, as often seen in *Quinqueloculina subrotunda*; but it takes quite another character in the composite or almost chitinous test of *Q. fusca*.

The latter species has, in place of the normal porcellaneous shell, an investment consisting of a horny membranous basis with imbedded sand-grains partially cemented by calcareous deposit. So little is the calcareous element essential to the solidity of the test, that prolonged treatment with an acid does not materially change its form or appearance; nor, beyond slightly increasing its transparency, does it appear to produce any alteration in its minute structure. A portion of the carapace of a specimen in its natural state is represented, highly magnified, at Pl. XI. fig. 3 *a*, and a similar piece, decalcified by strong acid, is shown in fig. 3 *b*; both are from preparations mounted in Canada balsam, and viewed by transmitted light.

The *Lituolida* with variable but essentially composite tests have their best brackish representative in *Trochammina inflata*. Under similar enfeebling conditions, they show a tendency to change in the same direction. The deposit of calcareous cement is diminished, and with it the foreign matter which forms so large a proportion of the "built-up" test of marine specimens, until the animal has often only the investment of a thin, nearly smooth, chitinous membrane. The change in the structure of the test is not accompanied by any diminution in size; on the contrary, the finest specimens of *Tr. inflata* we have seen were of this membranous sort.

The chemical nature of the investment is similar to that of *Quinqueloculina fusca*. Large specimens have been treated with nitric and hydrochloric acids, and strong solution of caustic potash, without sensible change, preserving sufficient solidity and firmness to permit of being mounted in Canada balsam, at the end of the process, without fracture.

The *Lagenida* do not appear to subsist where they are unable to produce their normal hyaline shell: no examples have been met with in the gatherings furthest removed from the sea; and in the other localities they do not differ from marine specimens.

Of the *Globigerinida* only two species require comment. A chitinous spherical test, brown in colour, but otherwise very closely resembling *Orbulina universa*, is not unfrequently found in brackish pools. The occasional specimens of *Orbulina* met with in the littoral and laminarian zones are commonly thin-shelled and dark-coloured; and it has more than once occurred to us whether these brackish organisms, which have been set down as belonging to the genus *Gromia*, might be the representatives of the normally calcareous species. Such an explanation seems the more possible from the fact that small examples of *Globigerina*, a genus almost invariably

associated in deep water with *Orbulina*, are not unfrequent in our brackish gatherings.

Rotalia Beccarii exhibits modifications of somewhat different nature; but, as they are morphological rather than structural, their description may be left to a subsequent page.

The *Nummulinida*, with higher organization, present no change under brackish conditions, beyond the thinning of the shell-wall and occasional tendency to wild growth. It is at first sight singular that, whilst the feebler species *Polystomella striatopunctata* and *Nonionina depressula* are everywhere abundant in estuarian pools, not even a straggling specimen of the typical *Polystomella crispa* has ever been met with, although it is one of the commonest of our marine species. The characters of the shell afford a probable explanation: for the thickening of the shell-wall and the formation of sutural ridges and spinous processes a larger supply of mineral constituents than can be derived from brackish water may be supposed to be essential. In the two common brackish species the test becomes thinner and more delicate as the proportion of saline matter diminishes, and often assumes a pale-green colour in the grassy pools which receive land-drainage and have only occasional communication with the sea.

The importance of these facts consists chiefly in the light they seem to cast upon the relation between some of the marine and freshwater groups of Protozoa. The physical and chemical characters of the investment appear from them to be, zoologically speaking, of limited value, and are not applicable always even to the whole of the specimens within the limits of a species. It has been shown, we think, beyond doubt that varieties of a normally compact and porcellaneous type like *Miliola* may secrete a carapace as chitinous as *Gromia* itself, when living for a succession of generations under circumstances which render the supply of calcareous material insufficient for the purpose of shell-building, and that a corresponding adaptation to altered life-conditions takes place in the normally rough and cemented tests of the *Lituolida*. The probability of similar modifications in the higher groups, such as that hinted at with reference to the *Globigerinida*, need not be insisted upon. The test in *Difflugia* presents no character that we know of to distinguish it from a single-chambered *Lituola*. How far the extension of the sarcode beyond the carapace, or its subdivision in the pseudopodia, yields a more stable basis for zoological classification, assuming its organization to be equally simple in the marine and freshwater testaceous groups (of course excluding the Polycystina), is a question upon which we are not yet prepared to enter.

Some genera of Rhizopoda are regarded as calcareous or arenaceous, and proper to the sea (*Foraminifera*), others as chitinous or arenaceous, and pertaining chiefly to fresh water (*Gromia* and *Difflugia*); the evidence afforded by specimens obtained under intermediate (brackish) conditions indicates the problem, whether *gradual modification of external circumstances*, with a large allowance of *time*, may not be held to account for many characters supposed to be of generic or even ordinal importance.

The Table representing the distribution of Foraminifera differs in several important particulars from that relating to the Ostracoda (pp. 27–33), and has been compiled with the intention of including as far as possible what is known of the occurrence of this class of Rhizopoda in brackish water, rather than their relation to tidal rivers exclusively. Some of the gatherings rich in Entomostraca contained no Foraminifera; of others record was kept of Ostracoda only: hence the omission of several columns which appear in the previous table. The converse is also true; and collections of Foraminifera from several additional brackish localities have been collated, in order to render the synopsis as comprehensive as circumstances admit.

Of Group I., pertaining to river-estuaries of England and Scotland, the following columns are omitted:—D, Warn Burn; I, River Ouse at Goole; J, River Humber; K, River Deben; L, River Stour; M, River Thames; and N, Fowey Harbour. Of Groups II. & III., referring to the English Fen-district and Holland, the following are wanting:—P, Whittlesea Dyke; X, Ormesby Broad; Z, Lake Lothing; C *c*, River Ouse, Norfolk; E *e*, River Maas. It is to be regretted that the Whittlesea-Dyke gathering has been mislaid, as it contained a preponderance of Foraminifera. The material from Ormesby Broad contained a considerable number of *Difflugiæ*, but no other Rhizopoda.

In the Table of Foraminifera the *letters* heading the columns correspond with those used for the same localities in that devoted to the Ostracoda, and the additional columns are referred to by *numbers* (1 to 15). A few brief memoranda concerning the localities not previously described are necessary to complete our topographical notes.

1. *River Tay, near Errol.*—A gathering taken south of Errol, between the river and the gamekeeper's house, in soft muddy gullies and lagoons. The shore for a considerable

distance at this place is made up of reedy ground traversed by channels interspersed with pools covered by the tide at high water.

2. *Frith of Forth*.—This material was dredged in three to four fathoms, twenty yards or so from the pier at Bo'ness. It was a soft slimy mud, the water being brackish, but not strikingly so. That the Rhizopodal fauna presents a closer approximation to that of the laminarian zone than most of the localities investigated, is readily explained by the wide communication with the open sea.

3. *Seaton Sluice*.—A sort of harbour at the *débouchement* of the Seaton Burn, about six miles north of the Tyne. The Rhizopoda were all of the commoner brackish type.

4. *Jarrow Slake*.—A large muddy expanse on the south side of the estuary of the Tyne, within a couple of miles of the sea. At low water the whole tract is left exposed, except the freshwater channel of a small tributary stream (the Don), which flows through it to its junction with the river. Samples of soft mud from various points of the surface left uncovered at low tide were collected for us by our friend Mr. Drewett Drewett of Jarrow Hall. Their examination only yielded specimens of four of the commoner brackish species.

5. *Hylton Dene*.—On the north bank of the river Wear, about two miles above Sunderland*. Several gatherings were made among the grassy pools, which have only occasional communication with marine water. The water in some cases showed only one per cent. of saline constituents.

6. *Hartlepool Slake*.—A muddy expanse between Hartlepool and West Hartlepool, running inland some distance and receiving the freshwater drainage of one or two rivulets, but covered by the sea at high tide. Our gathering, which was from some old mud, probably does not represent exhaustively the Rhizopoda of the locality.

7. *River Tees near Middlesbro'*.—The wide outspread estuary of the Tees is to a great extent a muddy flat at low tide. Somewhat removed from the bed of the river, on either side, are a succession of grassy pools and ditches, all more or less brackish. The material examined was obtained from situations of this sort on the south side.

8. *River Exe, Devonshire*.—From the gravelly stony river margin near Lympston, halfway between Exeter and Exmouth, near low-water mark (an exposed situation, too much affected by the wash of the tide for minute and delicate organisms, and

* For a detailed account of the zoology of this interesting locality, see Trans. Tyneside Nat. Field-Club, vol. vi. p. 95.

presenting a correspondingly meagre fauna), a few Ostracoda were noticed of the following species:—

Cythere porcellanea, *Brady.*	Paradoxostoma Fischeri, *G. O. Sars.*
—— castanea, *G. O. Sars.*	—— hibernicum?, *Brady.*

9. *Estuary of the Ribble.*—We are indebted to Mr. E. C. Davison for a sounding from this locality. It consisted of fine sand; and though the quantity was very small, it contained microzoa of considerable interest. The only specimen of *Uvigerina irregularis* that has been found on the west coast occurred in it.

In the *second* group, which is confined to the Fen area, no additional localities are included in the table.

The *third* group is somewhat miscellaneous, and is almost entirely new. It consists chiefly of the results of collecting on the west of Scotland. The Scheldt gathering and one from the west of Ireland are, to save further division, placed in the same set.

10 & 11. *Loch-in-Daal* and *Loch Grunard.* The former locality is the large bay facing southwards, the latter the smaller inlet opening northwards in the island of Islay. In both of these a large marshy tract extends inland, portions of which are only covered at the highest tides; and we are indebted to Mr. R. Y. Green for parcels of mud obtained from the grassy pools above the ordinary high-water marks. Though differing considerably, both gatherings are eminently brackish; that from Loch Grunard contained the only specimen of *Trochammina squamata* we have yet met with under such conditions—indeed, with the exception of rare examples from deeper water among the Hebrides, the only one hitherto found on the British coast.

12. *Portree Harbour, Isle of Skye.*—Sandy mud obtained near the point where a small stream empties itself into the sea, a little above high-water mark. For this material we are indebted to Mr. Joseph Wright, of the Newcastle Museum.

13. *Loch Gilp.*—A gathering procured from a small burn at a point only reached by the sea for a short time at high water. The bottom was mud and small gravel, deeply coloured with ferruginous deposit. The number of species very limited.

14. *Westport, Ireland.*—From a brackish pond subject to the tide, but never left dry; depth, two to three fathoms; bottom, sandy gravel; the water in some degree brackish, from the influx of a small stream. The fauna indicates more nearly marine conditions than most of those included in the Table, and is remarkable from containing specimens of *Ver-*

neuilina spinulosa—its first recorded occurrence on the British coast.

15. In a separate division a summary of the results of Messrs. Parker and Jones's researches on the Foraminifera of the clay underlying the peat in the Fen district is given, in order to facilitate the comparison of the prehistoric fauna of this interesting area with that at present existing. It is compiled from four columns in their "Table of the North-Atlantic and Arctic Foraminifera, with their Distribution in other Seas" (Phil. Trans. vol. clv. p. 422, table vii.), headed respectively as follows:—

"1. *Subrecent. Peterborough Fen, one mile from its western boundary (sandy clay).*
"2. *Subrecent. Peterborough Fen, two miles from its western boundary (sandy clay).*
"3. *Subrecent (clay). Boston, Lincolnshire.*
"4. *Subrecent (clay). Wisbeach, Cambridgeshire (Valley of the Nene).*"

Setting aside the last column, which need not affect general considerations, the groups into which the Table is divided have a purely geographical basis. Reference to physical conditions, such as depth, proportionate admixture of fresh water, proximity to the open sea, and the nature of the bottom, would give a somewhat different classification, and one bearing more closely upon zoological relations.

So divided, a first series would embrace those localities in which, either owing to wide and easy communication with the ocean or a relatively small influx of fresh water, the Rhizopod fauna approximates in some degree to that of the littoral and laminarian zones. Seven of the columns might be comprised under this head, viz.:—B, Montrose Basin; C, Budle Bay; E, River Aln; G, River Wansbeck; H, River Blyth; 2, Frith of Forth; and, 14, Westport, Ireland. Columns 9, River Ribble, and D *d*, River Scheldt, probably belong to the same series; but a deficiency of material for examination leaves some uncertainty with respect to them. The presence of *Quinqueloculina fusca*, *Trochammina inflata*, and *Rotalia Beccarii*, and the abundance of *Polystomella striatopunctata* and *Nonionina depressula*, may be accepted as the most characteristic indication of the constant admixture of fresh water; and three of these seven localities, notwithstanding their marine affinities, answer in every particular to this test. In four of them *Quinqueloculina fusca* gives place to stronger marine species; and in one, *Trochammina inflata* is replaced by *Lituola canariensis*. On the other hand, the series presents a large number

of additional species, which may be regarded as "semi-brackish"—in other words, such as will tolerate in a limited degree brackish conditions, whilst normally marine in their habit. The most conspicuous of these belong to the genera *Lagena* (of which almost every British variety occurs), *Bulimina*, *Bolivina*, *Discorbina*, *Truncatulina*, and *Patellina*. Reference to the Table will extend the category, and show the particular forms which occur.

A second series would comprise those areas which are further removed from marine influence, either by greater distance from the coast-line or other circumstances of position. This would include the gatherings made higher up river-estuaries, the "salt grass" of estuarian marshes, and the pools of swampy ground only covered by the sea at exceptionally high tides. Such situations are represented by thirteen columns, viz.:—A, River Clyde; F, River Coquet, at Warkworth Hermitage; 1, River Tay, at Errol; 3, Seaton Sluice; 4, Jarrow Slake; 5, River Wear at Hylton Dene; 6, Hartlepool Slake; 7, River Tees, near Middlesborough; 8, River Exe, near Lympston, and the four Western Scottish gatherings, 10, 11, 12, and 13. Situations of this sort are characterized by the presence generally of the five species before named, with the occasional addition of certain other forms—notably *Quinqueloculina seminulum*, *Q. subrotunda*, *Lituola canariensis*, and *Truncatulina lobatula*.

A third series would embrace the Fen localities, which, zoologically as well as geographically, stand by themselves, the fauna consisting, as already stated, of the species which have survived the gradual change in the surface-contour of that district.

Testaceous Rhizopoda of the *lower* types are often so perishable in their nature that the investments of many are destroyed or their characters obliterated by the mere process of washing and drying the muddy material in which they live. As most of the examinations were necessarily made on material so treated, there is little to offer with respect to the organisms standing immediately lower in the scale; but as their relation to the Foraminifera is very intimate, a mere enumeration of those which have been noticed and the localities in which they were taken will tend to general completeness. This unfortunately cannot be extended beyond the *Difflugiæ*. Dr. Wallich's excellent plate (Ann. & Mag. Nat. Hist. ser. 3. vol. xiii. pl. 16, March 1864) will be a convenient basis of reference.

The typical *Difflugia pyriformis* of Carter (Ann. vol. xiii. pl. 1. fig. 1, Jan. 1864; Wallich, *loc. cit.* figs. 9, 10) is by far the commonest form. It was found in the Coquet, the Wans-

beck, the Tay, the dykes on the site of Whittlesea Mere, the river Cam at Ely, in Barton Broad, Ormesby Broad, Somerton Broad, Horsey Mere, and Hickling Broad. In Ormesby Broad it was the only Rhizopod discovered, no Foraminifera being present in the gathering.

Difflugia mitriformis, the long form (*loc. cit.* fig. 12) was found in the Coquet, the single-horned variety (fig. 7) in the same gathering and in the river Cam at Ely, and the two-horned variety (fig. 8) in the latter locality only.

Difflugia arcella (figs. 34–38) occurred in the river Blyth and in Whittlesea Dykes.

Difflugia globularis (fig. 21), somewhat doubtful specimens in Whittlesea Dykes and in the river Cam at Ely.

One or two specimens of another organism, apparently closely allied to *Difflugia*, were found in Whittlesea Mere. Our friend Mr. H. J. Carter, F.R.S., who has kindly examined the mountings pertaining to this division of the subject, fails to recognize it as a known species. The test is globular, with a narrow, much curved neck, as long as the diameter of the body, rising abruptly from the periphery. In texture it appears to be completely mineralized (calcareous?) ; the surface is white, and scarcely rougher than is often seen in Foraminifera of some of the normally hyaline genera. In general form it is not altogether unlike Dr. Wallich's figures of *Difflugia spiralis* (*loc. cit.* figs. 24, 24 *a*, 25) ; but the neck is narrower and longer, and the test, if composite, is built on a different plan, and with much more finely divided materials.

The following is a detailed synopsis of the Foraminifera :—

Cornuspira foliacea, Philippi, sp.

Orbis foliaceus, Philippi (1844), Enum. Moll. Sicil. vol. ii. p. 147, pl. 24. fig. 26.

Very rare. The only satisfactory specimens are from two Northumbrian localities, Budle Bay and the Blyth estuary. A single imperfect shell, obtained from the Montrose Basin, much resembles this species, but may have belonged to an annelid.

Biloculina ringens, Lamarck, sp.

Miliolites ringens, Lamarck (1804), Ann. Mus. vol. v. p. 351, vol. ix. pl. 17. fig. 1.

The "Biloculine" *Miliolæ*, so common in really marine situations at any part of our coast, are comparatively scarce where any admixture of fresh water occurs. The subtype *B. ringens* has been found only in the Montrose Basin, which, as has been pointed out, is one of the least-brackish areas admitted into our Table.

Biloculina elongata, D'Orbigny.

Biloculina elongata, D'Orbigny (1826), Ann. Sci. Nat. vol. vii. p. 298. no. 4.

Estuaries of the Wansbeck and Blyth, and in the river Bure at Yarmouth; in all cases rare.

Biloculina depressa, D'Orbigny.

Biloculina depressa, D'Orbigny (1826), Ann. Sci. Nat. vol. vii. p. 298. no. 1, Modèle no. 91.

The compressed, carinate, feebler form of *Biloculina* occurs sparingly in four out of our five Northumbrian gatherings; elsewhere it has not been met with.

Spiroloculina limbata, D'Orbigny.

Spiroloculina limbata, D'Orbigny (1826), Ann. Sci. Nat. vol. vii. p. 299. no. 9; Soldani, Testaceographia, vol. iii. p. 229, pl. 154. fig. *hh*, and pl. 155. fig. *ii*.

Budle Bay and Blyth; rare.

Triloculina trigonula, Lamarck, sp.

Miliolites trigonula, Lamarck (1804), Ann. Mus. vol. v. p. 351. no. 3; (1822) Anim. s. Vert. vol. vii. p. 612. no. 3.

The "Triloculine" *Miliolæ* found in brackish water belong almost exclusively to the elongate emaciated variety (*T. oblonga*); nevertheless one or two well-grown specimens of the subtype have been met with in Breydon Water, as well as the weaker form.

Triloculina oblonga, Montagu, sp.

Vermiculum oblongum, Montagu (1803), Test. Brit. p. 522, pl. 14. fig. 9.

There is no real boundary-line between *Triloculina* and *Quinqueloculina*; and many specimens assigned to *T. oblonga* might with almost equal reason be placed in the latter genus.

Moderately common in Montrose Basin, the Wansbeck estuary, and Breyden Water; rare in Budle Bay, the Aln, the Bure, and at Westport.

Quinqueloculina seminulum, Linné, sp.

Serpula seminulum, Linné (1767), Syst. Nat. 12th ed. p. 1264. no. 791.

The central type around which the whole of the *Miliolæ* may be grouped, and one of the commonest and most widely distributed, especially in shallow water, is not unfrequent amongst brackish microzoa. Reference to the Table will show that it has been found in the same number of localities as the essentially brackish variety, *Q. fusca*; but in comparative abundance of specimens the latter greatly preponderates. The

examples of *Q. seminulum* from subsaline sources are generally small and thin-shelled; and they show a tendency to run into outspread varieties, such as *Q. subrotunda.*

Quinqueloculina subrotunda, Montagu, sp.

Vermiculum subrotundum, Montagu (1803), Testacea Britannica, p. 521.

Especially common in the Northumbrian gatherings; occurs also in the dykes on the site of Whittlesea Mere and in the river Bure at Yarmouth, but not observed in the "broads" or elsewhere in the fen-waters.

Quinqueloculina Candeiana, D'Orb. Pl. XI. figs. 1 *a*, *b*.

Quinqueloculina Candeiana, D'Orb. (1840), Foram. Cuba, p. 170, pl. 12. figs. 24–26.

A beautiful *Miliola* which was found in the river Cam at Ely resembles the *Quinqueloculina Candeiana* of D'Orbigny more nearly than any other figured species; and though some points of difference may be detected, they are not of sufficient importance to justify varietal separation, at any rate on the basis of a single individual. The Fen specimen is more outspread than D'Orbigny's figure; the margin is expanded into a wide, delicately thin carina, and the exposed edges of the inner chambers are acute. Our friend Prof. Rupert Jones recognizes our figures from their resemblance to a fossil specimen found by him some years ago, and referred provisionally to this species.

Too little importance can hardly be attached to the minute morphological variations of the *Miliolæ*, as specimens pertaining to the group are to be found presenting every possible modification of contour and relation of parts consistent with a certain general plan of growth. The peculiarities of the present specimen, though noteworthy, are quite within what may be regarded as the specific limits of *Quinqueloculina seminulum.*

Quinqueloculina fusca, n. sp. Pl. XI. figs. 2 *a–c*.

Quinqueloculina agglutinans, H. B. Brady (1865), Nat. Hist. Trans. Northumb. and Durham, vol. i. pp. 87, 95.

A very variable Milioline Foraminifer, generally Quinqueloculine in the arrangement of its chambers, but often approaching *Spiroloculina*, on the one hand, in large outspread examples, whilst, on the other, starved individuals are sometimes definitely Triloculine. Its distinctive characters may be stated as under:—

Test composite, only slightly calcareous, usually formed of sand-grains imperfectly cemented upon or imbedded in a

chitinous, almost membranous basis. Colour variable, usually brown. Aperture large and conspicuous, equal in size to the transverse section of the terminal chamber, with which it corresponds in form. Length $\frac{1}{75}$ inch.

In the "Catalogue of the Recent Foraminifera of Northumberland and Durham" (*loc. cit.*) some specimens of this species, found at Hylton Dene, were described as "a feeble variety of *Quinqueloculina*, in which the normal, white, porcellaneous shell is replaced by a composite test composed of arenaceous particles imbedded in a chitinous matrix, with but little calcareous matter;" and they are there referred to *Q. agglutinans*, D'Orb. Subsequent examination of specimens, obtained from many different localities, of the species originally described by D'Orbigny under that name have led to the conviction that the variety so common in brackish water is quite distinct from it.

Q. agglutinans resembles the type *Q. seminulum* in general form, in septation, and with respect to its aperture; it has a large, bold, thick-walled shell, and, so far as our own coast is concerned, is only found in its deeper waters. The surface of the shell is rough; and the constituent sand-grains are of appreciable size, and often prominent. It appears to have a sort of selective power with respect to the material used in the construction of the test, dependent possibly on some physical peculiarity of surface in the sand-grains themselves; for specimens completely soluble in hydrochloric acid have been found in sand containing only a small percentage of calcareous matter. Under any circumstances, acetic or hydrochloric acids completely disintegrate, even when they do not entirely dissolve, the shell.

In contrast to these characters, the present species, *Quinqueloculina fusca*, is very indefinite in form and septation. Our drawing (Pl. XI. figs. 2 *a–c*) represents the appearance of some of the best-developed specimens; but a large proportion of those met with in any brackish gathering run into the feebler Milioline forms, often elongate and narrow, sometimes outspread and thin, according to their tendency towards *Triloculina* on the one hand or *Spiroloculina* on the other. The test itself is always coloured, usually brownish, slightly rough externally, and thin-walled. Its structure has been already alluded to (p. 276). Plate XI. fig. 3 *a* represents a piece of the test mounted in Canada balsam and viewed by transmitted light under a power of 200 diameters; *b* is another portion, decalcified by means of strong acid, and mounted in the same way. These drawings have been made to show to how small

an extent calcareous or earthy constituents are concerned in its formation.

Quinqueloculina fusca is by far the commonest of the brackish *Miliolæ*; and reference to the Table will show how exclusively it affects brackish localities. In the columns devoted to the areas least affected by the influx of fresh water (such as Montrose Basin, Budle Bay, the estuaries of the Blyth, Forth, and Ribble) it is comparatively absent. In those representing the Fen district it is also wanting, except in Hickling Broad and the river Bure. But in the estuarian pools of Northumberland and Durham generally it is quite common, and in the brackish shallows of the lochs on the west of Scotland it is invariably to be found. In the Westport gathering (Clew Bay) it is abundant.

Quinqueloculina secans, D'Orbigny.

Quinqueloculina secans, D'Orb. (1826), Ann. Sci. Nat. vol. vii. p. 303. no. 43, Modèle no. 96.

Rare in brackish water; found with other marine species at Budle Bay, in the Wansbeck, and in the Blyth: one or two specimens also from Hartlepool Slake.

Quinqueloculina bicornis, Walker & Jacob, sp.

Serpula bicornis, Walker & Jacob (*fide* Kanmacher) (1798), Adams's Essays on the Microscope, 2nd ed. p. 633, pl. 14. fig. 2.

Observed only in Budle Bay. It is a common marine species on the Northumberland coast.

Trochammina squamata, Parker & Jones. Pl. XI. fig. 4.

Trochammina squamata, Parker & Jones (1861), Quart. Journ. Geol. Soc. vol. xvi. p. 304. no. 88.

The typical *Trochammina squamata* is almost unknown as a recent British species, one or two specimens from Mr. Jeffreys's Hebrides dredgings in 1866* being the only previous instance of its occurrence in our seas. The shell figured at Pl. XI. fig. 4 was also found in a Hebrides locality (Loch Grunard, Islay), but in brackish water and associated with *Quinqueloculina fusca* and other microzoa of similar habit. It has the characteristic, brown, rough, scale-like test, with irregular surface and very obscure septation. The terminal portion of the spire is somewhat broken, as shown in the figure.

* See "Notes on the Rhizopodal Fauna of the Hebrides," Brit. Assoc. Report, 1866, (Transactions) p. 69.

Trochammina inflata, Montagu, sp.

Nautilus inflatus, Montagu (1808), Suppl. Testacea Britannica, p. 81, pl. 18. fig. 3.

Rotalina inflata, Williamson (1858), Rec. For. Gt. Brit. p. 50, pl. 4. figs. 93, 94.

This species has been carefully studied by Messrs. Parker and Jones from specimens washed out of the clay which underlies the peat in the Fen district near Peterborough. The organic remains contained in this deposit can scarcely be regarded as fossil, as little alteration has taken place in their physical characters, and they represent probably the direct ancestry of the living microzoa of the neighbouring brackish waters. As the distance has increased between the inland fen area and the open sea, and the fen-waters have become in consequence less saline, the present species, amongst others, has grown correspondingly less common, and its distribution limited to a few localities most favourable to its habit.

Trochammina inflata is alike variable in its external contour and appearance and its choice of a habitat. The specimens originally described by Col. Montagu were from the Devonshire coast, Prof. Williamson's from Mr. Barlee's and Mr. Jeffreys's dredgings at various points around the British Isles; but whilst the species is extremely rare in these dredged sands, it is one of those most commonly met with in the mud of shallow lagoons.

The deep-water (marine) specimens in our possession differ somewhat from the brackish type; they are smaller, thicker in proportion, have fewer chambers in each whorl, and show deep constrictions at the septa, especially in the under surface. Specimens with these characters were obtained from depths of fifty fathoms and upwards at two or three points on the west coast of Scotland. We have no record of its occurrence in the coralline or the laminarian zone, though it can scarcely be supposed to cease entirely in intermediate depths.

Professor Williamson's figures (*loc. cit.*) represent excellently what may be regarded as the typical form; and corresponding examples are abundant in brackish pools. There is, however, in addition, an emaciated variety not uncommon in the same localities, diverging from the type in an exactly opposite direction to the deep-water form just alluded to, and presenting about equal morphological affinity to *Trochammina inflata* and *Lituola canariensis*. A recent examination of a very large number of Lituoline Foraminifera from various localities and depths of water on the western shores of Scotland afforded the clearest evidence that no truly specific, still less generic, distinction could be drawn between *Valvulina* (*V. co-*

nica and *V. austriaca*), *Trochammina* (*T. squamata* and *T. inflata*), and *Lituola* (*L. canariensis*). The series of arenaceous Foraminifera so brought together runs through the whole of the "species" named above in parentheses, and is without a break; indeed it may be said that any decision as to the naming of many of the specimens is purely arbitrary. It may be admitted that *Valvulina* has normally only three chambers in each whorl, and that fine specimens sometimes show a perforate primary shell *, that many *Trochamminæ* have tests in which the calcareous cement is largely in excess of the imbedded sand-grains, and that *Lituola* in its finer developments has a coarse, rough, sandy investment; but the series adverted to yields specimens with complete admixture of these supposed generic characters †. Pending the rearrangement of the group, it has been thought best to give a sort of varietal distinction to the complanate specimens above mentioned; and a separate line is accorded to them, under the name *Tr. macrescens*, in the Table.

Little need be added to the particulars contained in the Table respecting the distribution of *Tr. inflata*. It has been found in about one half of the localities searched; but, in the inland Fen area, living specimens have only been noted at a few points.

Trochammina inflata, var. *macrescens*. Pl. XI. figs. 5 *a–c*.

Characters.—Test nautiloid, complanate. Chambers numerous, thin, concave. Septal plane narrow. Texture mem-

* Occasional specimens belonging to the genus *Involutina*, another subarenaceous type scarcely separable from *Trochammina*, but limited in its distribution, so far as at present known, to rocks of the Carboniferous and Liassic periods, show this same character (unusual to the *Lituolida*), a perforated primary shell-wall. See Geol. Mag. November 1864, pl. 9. fig. 6.

† Whilst on the subject of the present arrangement of the arenaceous Foraminifera, I may hazard the view that *Lituola canariensis* is in far closer relationship with the *Trochammina* series than with either *Lituola nautiloidea* or *L. scorpiurus*. There is considerable distinction, again, between these two latter "species." Lamarck's typical form (*L. nautiloidea*), the Hebrides variety of which Professor Williamson figures well as *Proteonina pseudospiralis* (Rec. For. Gt. Br. pl. 1. figs. 2, 3), differs as much in texture and surface and in the character and deposition of its "cement" from *L. scorpiurus* as it does in external form; and as this is equally true when the two occur together in considerable numbers in the same handful of sand, their diverse characters can scarcely be the result of external conditions.

It would be premature to make any material alteration in nomenclature until the result of Dr. Carpenter's researches on the larger arenaceous Rhizopoda obtained in the recent deep-sea explorations are made public. The subject is beyond the scope of the present paper.—H. B. B.

branous, subarenaceous, scarcely calcareous. Colour brown. Long diameter $\frac{1}{65}$ inch.

That the thin outspread nautiloid *Trochamminæ* which abound in some localities are the result of depauperating external influences, possibly extended through very many generations, is most probable, the only alternative supposition being that they are passage forms between the chitinous and arenaceous groups of Rhizopoda. Accepting the former view, the difficulty remains whether the complanate specimens approximate most nearly to *Lituola canariensis* or *Trochammina inflata*, if, indeed, these two are not the same species. The preference for associating them with *Tr. inflata* is founded rather on the extreme tenuity of the test, its membranous nature, and its agreement in chemical relations, than on morphological peculiarities. Supposing the connexion with *Tr. inflata* to be such as has been indicated, there is a manifest convenience in distinguishing the variety by name in the same way as the starved conditions of other genera are recognized. The chemical characters of the test have been before described. The concavity of the individual chambers is due in great degree to the falling-in of the walls from the contraction of the sarcode in drying; but in some specimens with thin square edge, and having a general contour not unlike limbate *Operculinæ*, appearances are against the supposition that the segments ever were convex.

Lituola scorpiurus, Montfort, sp.

Reophax scorpiurus, Montfort (1808), Conchyl. Syst. vol. i. p. 330, 83e genre.

A single specimen only, and that of the stunted form with obscure septation which alone appears on the east coast. It was found in the scarcely brackish material from the Forth.

Lituola canariensis, D'Orbigny, sp.

Nonionina canariensis, D'Orbigny (1839), Nat. Hist. Canaries, p. 128, pl. 2. figs. 33, 34.

Not uncommon in the more marine localities; in the areas most influenced by the influx of fresh water it often gives place to *Trochammina macrescens*.

Lagena sulcata, Walker & Jacob.

Serpula (*Lagena*) *sulcata*, Walker & Jacob (*fide* Kanmacher) (1794), Adams's Essays on the Microscope, 2nd ed. p. 634, pl. 14. fig. 5.

This, the typical form of *Lagena*, is also the commonest in brackish water. Its absence is conspicuous in the estuarian pools of the Tay, Tyne, Wear, Tees, and Exe, and in

the five western Scottish localities contained in our Table, but through the remainder of the list it is pretty evenly distributed.

Lagena Lyellii, Seguenza, sp. Pl. XI. fig. 7.

Amphorina Lyellii, Seguenza (1862), Foram. Monotal. Mioc. Messin. p. 52, pl. 1. fig. 40.
—— *costata*, id. ibid. p. 52, pl. 1. fig. 41.

It may be fairly questioned whether it is worth while to separate *Lagena Lyellii* from its direct type *L. sulcata*. Regarding it as the distomatous variety of the latter species, its distinctive characters are of the same value as those of *L. distoma* and *L. gracillima*; and the same rule as to recognition should be observed in respect to all three. In addition, however, to the second or basal neck and orifice, all the specimens of *Lagena Lyellii* we have met with possess a second mark of peculiarity in the exogenous spirally arranged deposit of shell-substance investing the superior neck. The supplementary or basal neck commences abruptly from the centre of the lower end of the shell, and is sometimes curved or obliquely set. In the other distomatous forms alluded to the shell tapers towards the lower as towards the upper orifice, although generally more rapidly.

This variety was one of the numerous interesting *Lagenæ* found in the deep-water sands dredged by Mr. Jeffreys in 1866 amongst the Western Isles *. The particular localities were "the Minch," "off Skye," and "Loch Eriboll;" and in every case it was very rare. It is singular that the deep-water shells should have in some instances the same irregular, apparently distorted lip that our brackish specimens both present (see figure).

But two brackish-water examples have occurred in these examinations—one from the Frith of Forth (Bo'ness), the other from the Montrose Basin.

Lagena lævis, Montagu, sp.

Vermiculum læve, Montagu (1803), Testacea Britannica, p. 524.

Distribution almost exactly corresponds with that of *L. sulcata*, but it is not quite so common.

Lagena gracillima, Seguenza, sp. Pl. XI. figs. 6 *a–c*.

Amphorina gracillima, Seguenza (1862), Foram. Monotal. Mioc. Messin. p. 51, pl. 1. fig. 35.

Lagena gracillima has scarcely been recognized hitherto as a British recent species, and it is best known as a Tertiary

* British Association Reports, 1866, (Transactions) p. 70.

fossil. It is described and figured in the 'Monograph of the Crag Foraminifera,' p. 45, pl. 1. figs. 36, 37, where a succinct account of its peculiarities and distribution may be found. It is, morphologically speaking, the distomatous variety of *Lagena lævis*.

Lagena gracillima is frequently met with in Northumbrian estuaries. In the Fen district it has only been noticed at one point, Breydon Water. It also occurs in two localities far apart, but similar in tidal relations, viz. Montrose Basin and Westport, Ireland.

Lagena globosa, Montagu, sp.

Vermiculum globosum, Montagu (1803), Testacea Britannica, p. 523.

Not uncommon in river-estuaries where there is sufficient admixture of sea-water; sparingly found in most of the Fen gatherings.

Lagena striata, D'Orbigny, sp.

Oolina striata, D'Orbigny (1839), Foram. Amér. Mérid. p. 21, pl. 5. fig. 12.

In the Northumbrian estuaries and Montrose Basin; one or two specimens also from the mouth of the Ribble.

Lagena semistriata, Williamson.

Lagena striata, var. *β. semistriata*, Williamson (1848), Ann. & Mag. Nat. Hist. ser. 2. vol. i. p. 14, pl. 1. figs. 9, 10.

Less frequent than *L. striata* in estuaries, but found in some Fen localities, where the latter species has not been observed at all, viz. dykes on the site of Whittlesea Mere, Somerton Broad, and Breydon Water.

Lagena distoma, Parker & Jones.

Lagena sulcata, var. *distoma*, Parker & Jones (1864), Phil. Trans. vol. clv. p. 356, pl. 13. fig. 20.

Somewhat common in the Northumbrian estuaries and in the Montrose Basin.

This is one of the species that seems to have died out of the fen-waters as the proportion of saline constituents has diminished; for it is of frequent occurrence, amongst other scarcely fossilized Foraminifera, in the clay underlying the peat as far inland as Peterboro' (*Parker*).

Lagena marginata, Walker & Jacob, sp.

Serpula (Lagena) marginata, Walker & Jacob (1784), Test. Min. p. 3, pl. 1. fig. 7.

Found in exactly the same gatherings as *L. distoma*. Con-

fined to the more marine localities of Northumberland and the questionably brackish Montrose Basin.

The obscurely quadrangular, compressed, subvarietal form named by Professor Williamson *Entosolenia marginata*, var. *quadrata* (Rec. For. Gt. Br. p. 11, pl. 1. figs. 27, 28), was observed amongst the Wansbeck and Budle-Bay microzoa.

Another subvarietal form, *Entosolenia marginata*, var. *lucida*, Williamson (Rec. For. Gt. Br. p. 11, pl. 1. figs. 22, 23), was found in three localities, viz. Montrose Basin, Wansbeck, and Frith of Forth.

These two modifications, dependent for their distinction on very trifling morphological peculiarities, are not of sufficient importance to need record in the Table of distribution.

Lagena ornata, Williamson, sp.

Entosolenia marginata, var. *ornata*, Williamson (1858), Rec. For. Gt. Br. p. 11, pl. 1. fig. 24.

A few specimens from Montrose Basin and a still smaller number from Budle Bay are all that have come under our notice. This is altogether a rare form on the British coast, though its distribution is not particularly restricted in a geographical sense, and it has been repeatedly noticed as a Tertiary fossil.

Lagena pulchella, Brady. Pl. XII. figs. 1 *a*, *b*.

Lagena pulchella, H. B. Brady (1866), Brit. Assoc. Reports, (Transactions) p. 70.

In a short notice of the Rhizopodal fauna of the Hebrides (*loc. cit.*) this species was described as follows, but was not figured:—

"Characters as *L. marginata*, W. & J., to which it is closely allied, but differing in having a number of delicate parallel costæ springing from the base and extending into the upper half of the shell, in some specimens nearly to the aperture."

A single example of this curious carinate *Lagena*, differing from the Hebrides specimens only in its larger size and correspondingly exaggerated surface-peculiarities, was found in the mud of the Scheldt near Antwerp. The Scottish specimens resemble *L. marginata* in their general form much more closely than this, and the costæ are more delicate and regular; but these are minor characters of deviation, not requiring separate recognition.

We have no instance of the occurrence of *L. pulchella* in brackish water, except the one specimen above alluded to, though it has been found in a part of the Frith of Forth (in-

side Granton Harbour) that just escapes the range of the present paper. A considerable number of specimens were found in a dredging from Fintry Bay, Cumbrae, in 10 to 12 fathoms.

Lagena squamosa, Montagu, sp.

Vermiculum squamosum, Montagu (1803), Testacea Britannica, p. 526, pl. 14. fig. 2.

Rare in Montrose Basin and the north-eastern estuaries; still rarer in the Fen gatherings; entirely absent from the brackish areas examined on the west of Scotland.

Lagena melo, D'Orbigny, sp.

Oolina melo, D'Orbigny (1847), Foram. Amér. Mérid. p. 20, pl. 5. fig. 9.

Very rare; single specimens from Montrose Basin and the estuaries of the Alne and Blyth. Again one specimen alone amongst the Fen microzoa (Breydon Water).

Glandulina lævigata, D'Orbigny.

Nodosaria (Glandulina) lævigata, D'Orbigny (1826), Ann. Sci. Nat. vol. vii. No. 1, pl. 10. figs. 1–3.

A solitary example from the Scheldt near Antwerp is the only occurrence of *Glandulina lævigata* in brackish water we have note of.

It is altogether rare as a recent species. Mr. Waller found three or four specimens in deep water off Shetland; and Messrs. Parker and Jones obtained it off the coast of Norway. It is difficult to account for its presence in the Scheldt. The other microzoa (except *Lagena pulchella*) were of the ordinary brackish type, so far as could be judged from the limited number at our command.

Nodosaria scalaris, Batsch, sp.

Nautilus (Orthoceras) scalaris, Batsch (1791), Conchyl. Seesandes, pl. 2. figs. 4 *a, b*.

Montrose Basin, Frith of Forth, Budle Bay, estuary of the Blyth, amongst the most nearly marine of the localities named in the Table; in every case very rare and the specimens small.

Dentalina communis, D'Orbigny.

Nodosaria (Dentalina) communis, D'Orbigny (1826), Ann. Sci. Nat. vol. vii. p. 254. no. 35.

This species, common everywhere on our coast in really marine localities, does not flourish where the water contains less than its normal proportion of saline ingredients. A few very small examples from Montrose Basin, the Frith of Forth, and the estuary of the Aln constitute our collection from

brackish habitats. It has not been found living in the fen-waters nor in the localities examined in the west of Scotland.

Dentalina guttifera, D'Orbigny. Pl. XII. fig. 2.

Dentalina guttifera, D'Orbigny (1846), For. Foss. Vienne, p. 49, pl. 2. figs. 11–13.

Amongst the numerous *Dentalinæ* with subglobular fusiform chambers that have received specific names at the hands of one author or other, *D. guttifera*, as figured in the 'Vienna Basin' monograph, may be accepted as the best representative. D'Orbigny assigns to it the following specific characters:—"Test elongate, smooth. Chambers seven in number, pyriform, inflated, separated by constrictions so deep that the shell appears like a string of beads. The earliest chamber mucronate."

It is very rare to meet with perfect examples of so fragile a shell; and, under any circumstances, to set down a definite number of chambers as a specific character of a polythalamous Foraminifer is wholly untenable. With this exception, the description agrees with the specimens which have come under our notice. In form, the chambers are usually somewhat longer proportionally than in D'Orbigny's figures, and have their widest diameter somewhat below the centre, the upper portion of each tapering gradually to a capillary stoloniferous tube.

Dentalina guttifera may be regarded as the curved condition of *Nodosaria pyrula*. Although occasional specimens have been met with at other portions of the British coast, no notice of its occurrence has been published heretofore. In the brackish gatherings it has only been noted in two localities—Bo'ness (Frith of Forth) and the Blyth estuary.

Marginulina glabra, D'Orbigny. Pl. XII. figs. 3 *a*, *b*.

Marginulina glabra, D'Orbigny (1826), Ann. Sci. Nat. vol. vii. p. 259. no. 6, Modèle no. 55.

One or two specimens from Montrose Basin only. Chance specimens they might be called; for the species is of rare occurrence on the British coast, even under more favourable conditions. We have examples from deep water off the west of Scotland, but elsewhere on our shores have never met with it.

Cristellaria rotulata, Lamarck, sp.

Lenticulites rotulata, Lamarck (1804), Annales du Muséum, vol. v. p. 188. no. 3.

Not at home in brackish water, one very small example in the Blyth gathering being the only instance of its occurrence.

Cristellaria crepidula, Fichtel & Moll, sp.

Nautilus crepidula, Fichtel & Moll (1803), Testacea Microscopica, p. 107, pl. 19. figs. *g*, *i*.

Very rare; represented only by isolated specimens from the Wansbeck and Blyth respectively.

Polymorphina lactea, Walker & Jacob, sp.

Serpula lactea, Walker & Jacob (*fide* Kanmacher) (1798), Adams's Essays, 2nd ed. p. 634, pl. 24. fig. 4.

The typical form of *Polymorphina* seems to give place to a less compact variety, *P. compressa*, under the deteriorating conditions resulting from the admixture of fresh waters. Of the closely allied *P. communis* and *P. oblonga* the same holds true.

Each of these three species has been collected in two localities; but the occurrence of solitary specimens at a few points widely separated yields only the general indication of rarity.

Polymorphina communis, D'Orbigny.

Polymorphina (*Guttulina*) *communis*, D'Orbigny (1826), Ann. Sci. Nat. vol. vii. p. 226. no. 15, pl. 12. figs. 1–4, Modèle no. 62.

Very rare.

Polymorphina oblonga, Williamson.

Polymorphina lactea, var. *oblonga*, Williamson (1858), Rec. For. Gt. Br. p. 71, pl. 6. figs. 149, 149*a*.

Very rare.

Polymorphina compressa, D'Orbigny.

Polymorphina compressa, D'Orbigny (1846), For. Foss. Vienne, p. 243, pl. 12. figs. 32–34.

The least-rare variety of the genus; yet even *P. compressa* is almost confined to the more marine localities of the Table.

In the Fen gatherings specimens referable to *Polymorphina* are almost completely absent, and but for a solitary instance supplied by the dykes on the site of Whittlesea Mere, Breydon Water would stand alone as a Fen habitat; even here the specimens found have been few and small.

It is worthy of note that the closely allied group *Nodosarina*, which is found in one variety or other at every point on our coast, is, so far as appears, entirely wanting amongst the recent microzoa of the fen-waters.

Uvigerina irregularis, Brady.

Uvigerina irregularis, H. B. Brady (1865), Nat. Hist. Trans. North. & Durham, vol. i. p. 100, pl. 12. fig. 5.

The irregular *Uvigerina* with thin, smooth, porous shell is

extremely rare. It was obtained off Holy Island in 20 to 25 fathoms water, and has been found (fossil) in the Crag of Suffolk. A single specimen from the estuary of the Ribble completes the record of its distribution.

Orbulina universa, D'Orbigny.

Orbulina universa, D'Orbigny (1839), Foram. Cuba, p. 3. no. 1, pl. 1. fig. 1.

A variable species in external characters. Specimens from a greater depth than 50 fathoms are white or greyish yellow, often hyaline, and usually entirely calcareous. Sometimes, though rarely, they are rough externally, and bear a superficial resemblance to the finely arenaceous types. Those found in shallower water are almost invariably of a dark brown colour, and have a peculiar texture not truly arenaceous, yet often scarcely calcareous. It is very difficult to distinguish the brown examples of this species met with in inshore gatherings from the chitinous tests of some of the lower Rhizopoda.

Orbulina universa is at home in the deepest seas; in the coralline, laminarian, or littoral zone only an occasional, apparently chance specimen is to be found. Its occurrence is only noted in one column of the Table ("Budle Bay"); and the specimens from that locality may be set down without cavil as true *Orbulinæ*. But in several other brackish areas spherical tests have been found which almost certainly represent the same type modified still further by the deteriorating influence of shallow water and the deficiency of earthy salts.

Globigerina bulloides, D'Orbigny.

Globigerina bulloides, D'Orbigny (1826), Ann. Sci. Nat. vol. vii. p. 277. no. 1, Modèles nos. 17 and 76.

Like *Orbulina universa*, this is essentially a deep-water species. When first met with in brackish river-pools three or four miles inland, its occurrence was regarded as accidental and an explanation was sought in accordance with this view; but as other localities of similar nature were investigated, specimens, few in number and small in size, but to all appearance living, showed themselves amongst other living microzoa in districts widely apart, rendering it impossible to avoid the conclusion that *Globigerina bulloides* can accommodate itself not only to very shallow water, but to very different conditions, as to specific gravity and proportion of saline matter, from those which exist in its normal habitat*.

* What is here stated does not affect, on one side or the other, the mooted question whether *Globigerina lives* at the bottom of the sea or is exclusively pelagic in habit. Major Owen's researches show clearly that it is an important constituent in the surface-fauna of the mid-ocean; but

Specimens have been found in the rivers Wear and Blyth and in the Montrose Basin, localities pertaining to the first section of the Table. In the Fen area examples have been obtained from the river Nene at Peterboro' and from Somerton Broad. At Westport, in Ireland, and in Portree Harbour, Skye, it appeared in large numbers, a circumstance in some measure accounted for by the comparative proximity of deep sea.

Textularia sagittula, Defrance.

Textularia sagittula, Defrance (1824), Dict. Sci. Nat. xxxii. p. 177, liii. p. 344; De Blainville, Malacologie, p. 370, pl. 5. fig. 5.

Montrose Basin and Westport, Ireland; very rare.

Foraminifera of this genus appear to possess remarkably little power of adapting themselves to brackish water. The typical *Textularia sagittula* is common on our coast, even in very shallow situations, such as the rock-pools of the littoral zone; yet we have only two instances of its occurrence in localities influenced by fresh water. Reference to the Table will show that, excepting in three columns before described as representing localities in which the conditions appear to be more nearly marine than the rest, the entire genus is notably absent. Even in these three gatherings the varieties found were amongst the rarest of the microzoa.

Textularia variabilis, Williamson.

Textularia variabilis, Williamson (1858), Rec. For. Gt. Br. p. 76, figs. 162, 163, 168.

Montrose Basin and river Blyth; very rare.

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this is as far as proof goes. On the other hand, it can hardly be believed that the thick-walled heavy specimens so common at the sea-bottom had power of floating when fully grown. Another argument *per contra* exists in the fact that, whilst *Globigerinæ* are found (not commonly, it is true, but still with some frequency) in the sands of other seas, as, for instance, the German Ocean, we have never, after long experience with the towing-net in search of Entomostraca, met with a single free-swimming specimen, nor have we ever heard of one being so captured on our coast. Again, the evidence in respect to *Globigerina* ought to be equally applicable to the other species taken by Major Owen, yet no one has suggested that *Pulvinulina Menardii, P. Micheliniana, P. canariensis,* and *P. crassa* are exclusively pelagic species.

That sarcodic animals can live at the greatest depths, is sufficiently proved by the existence of *Bathybius*, which cannot be regarded in any other light than an actually living organism.

These observations are prompted by Mr. Jeffreys's note in No. 121 of the 'Proceedings of the Royal Society,' p. 443.

Textularia globulosa, Ehrenberg. Pl. XII. figs. 4 *a*, *b*.

Textularia globulosa, Ehrenberg (1839), Abhandl. Akad. Berlin (1838), p. 135. no. 60, pl. 4, several figs.

One or two specimens of an uncommon variety of *Textularia* having very globular segments were found in the Westport dredgings. Similar forms, some with more numerous chambers, others with fewer, have been figured by Continental authors. The *T. globulosa* of Ehrenberg (*loc. cit.*) takes precedence for purposes of nomenclature, though his specimens apparently were small and had generally but few chambers. M. Cornuel (Mém. Soc. Géol. France, 2e sér. vol. iii. p. 258, pl. 4. fig. 25) figures a very long attenuated *Textularia* with perfectly spherical chambers under the name of *T. elongata*. The *T. globulifera* of Reuss (Sitzungsb. k. Akad. Wissensch. vol. xl. p. 232, pl. 13. figs. 7, 8) is almost the counterpart of our own figures. The whole of these may very properly be included under one varietal name.

The Westport gathering was peculiar in interesting examples; it yielded *Textularia* and its allies. In addition to those named in the Table, one specimen was found with characters somewhat different from any thing we have met with hitherto. The test was thin and complanate, the periphery not constricted at the sutures, the face presenting numerous very oblique chambers separated by broad lines of clear shell-substance; it was unfortunately broken by the artist before the drawing was completed, a loss the more to be regretted as we had not been able to identify the species from published figures.

Textularia pygmæa, D'Orbigny.

Textularia pygmæa, D'Orbigny (1826), Ann. Sci. Nat. vol. vii. p. 263. no. 13, Modèle no. 7.

Montrose Basin; very rare.

Textularia difformis, Williamson.

Textularia variabilis, var. *difformis*, Williamson (1858), Rec. For. Gt. Br. p. 77, pl. 6. figs. 166, 167.

Montrose Basin; very rare.

Gaudryina pupoides, D'Orbigny. Pl. XII. figs. 5 *a*, *b*.

Gaudryina pupoides, D'Orbigny (1840), Mém. Soc. Géol. France, p. 44, pl. 4. figs. 22–24.

Montrose Basin; very rare, two or three specimens only.

Gaudryina pupoides has not before been found on the British coast; nor is it, under any circumstances, of common occurrence, either in a recent or fossil condition. The brackish

specimens have nearly the same contour as D'Orbigny's *G. pupoides*, the triserial chambers being obscure and constituting but a small proportion of the test; but the texture is as rough as that represented by the same author in his *G. rugosa*, which, however, can scarcely be regarded as a specifically distinct form.

Verneuilina spinulosa, Reuss. Pl. XII. figs. 6 *a–c*.

Verneuilina spinulosa, Reuss (1849), Denkschr. mathem.-natur. Cl. k. Akad. Wissensch. vol. i. p. 374, pl. 47. fig. 12.

Two specimens of this interesting triserial Textularian were found in the Westport dredgings. They are somewhat limbate at the sutures, and the edges are not so sharp as those from Tertiary sources, nor are the marginal spinous processes developed to the same extent; but in other respects their contour answers to Professor Reuss's figures. As *V. spinulosa* had not before been met with in British seas, it was questioned whether these might not be "derived" from fossiliferous beds in the neighbourhood; but there is no evidence in favour of such a supposition. The shells have all the appearance of living specimens, and they were associated with other Protozoa all obviously recent. Neither are there any strata on the shores of Clew Bay of an age at all likely to yield such species. Our good friend and colleague Mr. W. K. Parker has, with his usual kindness, examined these and some other specimens upon which questions might have been raised, and has confirmed the conclusions arrived at with respect to them.

Verneuilina polystropha, Reuss, sp.

Bulimina polystropha, Reuss (1846), Böhm. Kreid. vol. ii. p. 109, pl. 24. fig. 53.

Estuary of the Exe and Loch-in-Daal, Islay; rare.

Bulimina pupoides, D'Orbigny.

Bulimina pupoides, D'Orbigny (1846), For. Foss. Vienne, p. 185, pl. 11. figs. 11, 12.

Very rare; only noted at Westport; and the specimens there found were scarcely distinguishable from large stout examples of *B. ovata*.

Bulimina marginata, D'Orbigny.

Bulimina marginata, D'Orbigny (1826), Ann. Sci. Nat. vol. vii. p. 269, pl. 12. figs. 10–12.

In two or three northern habitats; very rare. Hardly to be considered a brackish species.

Bulimina ovata, D'Orbigny.

Bulimina ovata, D'Orbigny (1846), For. Foss. Vienne, p. 185, pl. 11. figs. 13, 14.

The commonest of the *Buliminæ*, indeed the only variety that accepts the brackish conditions without much deterioration. Its occurrence is confined to the northern localities, which, as before stated, present a fauna resembling that of the littoral and laminarian zones.

Bulimina elegantissima, D'Orbigny.

Bulimina elegantissima, D'Orbigny (1839), Voyage l'Amér. Mérid. p. 51, pl. 12. figs. 13, 14.

From the Montrose Basin and Frith of Forth; very rare.

Virgulina Schreibersii, Czjzek.

Virgulina Schreibersii *, Czjzek (1848), Haidinger's Natur. Abhandl. vol. i. p. 147, pl. 13. figs. 18–21.

Montrose Basin; very rare.

Bolivina punctata, D'Orbigny.

Bolivina punctata, D'Orbigny (1839), Voyage l'Amér. Mérid. p. 63, pl. 8. figs. 10–12 †.

Frequent in the northern estuaries, where the admixture of fresh water is not excessive. Absent from the Durham gatherings and those from the west of Scotland. Has not been found living at any point in the Fen district.

Bolivina plicata, D'Orbigny. Pl. XII. figs. 7 *a*, *b*.

Bolivina plicata, D'Orbigny (1839), Voyage l'Amér. Mérid. p. 62, pl. 8. figs. 4–7.

Distribution similar to that of the foregoing species (*B. punctata*), but rarer; confined to the Montrose Basin, the Frith of Forth, Budle Bay, and the river Blyth.

D'Orbigny, in his 'South America' monograph, describes three varieties of biserial *Buliminæ*, viz. *Bolivina punctata*, *B. plicata*, and *B. costata*. None of these are given in Professor Williamson's work as British species; but the first has been collected at many points of our coast, from Shetland southwards, on both sides of the island; the second (*B. plicata*) is now first recorded from British localities; whilst the

* The specific name is written *Schreibersiana* in the text of Czjzek's memoir, *Schreibersii* on the plate. The latter term is already in common use, and it does not seem worth while to change, though ordinarily the name adopted in the letterpress would take precedence.

† Figured in the Trans. Linn. Soc. vol. xxiv. pl. 48. fig. 9; and Nat. Hist. Trans. N. & D. vol. i. pl. 12. figs. 8, *a*, *b*.

third, though of extreme rarity, has been found by Mr. W. K. Parker in a shallow-water mud at Eastbourne, Sussex.

D'Orbigny's figures of *B. plicata* are, as usual, somewhat diagrammatic, designed from the theoretical morphology of the shell rather than its actual appearance.

Discorbina rosacea, D'Orbigny, sp.

Rotalia rosacea, D'Orbigny (1826), Ann. Sci. Nat. vol. vii. p. 273. no. 15, Modèle no. 39.

Noticed only in two or three of the more nearly marine gatherings in the north; scarcely at home in brackish water.

Discorbina globularis, D'Orbigny, sp.

Rosalina globularis, D'Orbigny (1826), Ann. Sci. Nat. vol. vii. p. 271. no. 1, pl. 13. figs. 1–4, Modèle no. 69.

Frequent in the northern estuaries and in Portree Harbour, but not hitherto observed living at any point in the Fen area.

Planorbulina mediterranensis, D'Orbigny.

Planorbulina mediterranensis, D'Orbigny (1826), Ann. Sci. Nat. vol. vii. p. 280. no. 2, pl. 14. figs. 4–6, Modèle no. 79.

Occurs generally in the Northumbrian estuaries, the Clyde, and Montrose Basin. Found sparingly in the river Bure at Yarmouth and in Breydon Water.

Truncatulina lobatula, Walker & Jacob, sp.

Nautilus lobatulus, Walker & Jacob (1798) (*fide* Kanmacher), Adams's Essays on the Microscope, 2nd. ed. p. 642, pl. 14. fig. 36.

Found in localities pertaining to each of the three divisions of the Table, but especially common in the Northumbrian estuaries. In the Fens it has only been observed in Oulton Broad and the river Bure at Yarmouth.

Truncatulina refulgens, Montfort, sp.

Cibicides refulgens, Montfort (1808), Conchyl. Systém. vol. i. p. 122, 31e genre.

Truncatulina refulgens is the conical variety of the last-named species, usually inhabiting deeper water. It is not common at any part of our coast, even under the conditions it most affects; so that it is not easy to account for its occurrence in Hickling Broad and Horsey Mere, especially in the entire absence of other Rotalian Foraminifera.

Rotalia Beccarii, Linné, sp.

Nautilus Beccarii, Linné (1767), Syst. Nat. 12th ed. p. 1162. no. 276.

Professor Williamson's figures (Rec. For. Gt. Br. pl. iv.

figs. 90–92) represent excellently the typical *Rotalia Beccarii* as it ordinarily occurs both under marine and brackish conditions. In some localities much affected by the influx of fresh water we have found a large proportion of the specimens assuming somewhat modified characters. The peculiarities of these brackish individuals are not of sufficient importance or sufficiently uniform to need even varietal separation as to name, but they are nevertheless of considerable morphological interest. Their divergence from the type is chiefly with respect to the size and general contour of the test, its texture, and the fitting together of the chambers. Our Plate XII. figs. 8 *a–c* represent a fair example, though many could have been chosen showing the peculiarities more strikingly. These shells are usually white and opaque rather than hyaline in texture; the spiral face is less convex than in the type, sometimes quite flat, the inferior side having a corresponding increase of convexity. The septation is much obscured, often scarcely discernible on the spiral face beyond the last-formed circlet of chambers, though more frequently, as in fig. 8 *a*, the division may be traced through a second turn of the spire. The septa are radial rather than, as in the type, very oblique. The diameter seldom exceeds $\frac{1}{40}$ of an inch and is commonly less, whilst that of the type is from $\frac{1}{30}$ to $\frac{1}{25}$ inch. There is often an angular appearance about the periphery of the brackish variety that is not easily conveyed in a drawing, but which, nevertheless, gives to the specimens a somewhat peculiar aspect.

Rotalia Beccarii is one of the most widely distributed of all the brackish Rhizopoda, although the relative number of individuals is not nearly so large as those of the genera *Polystomella* and *Nonionina*. The particulars noted in the Table refer to the distribution of the typical form; the brackish modification of the type above described occurs in the river Bure and in the Tyne (Jarrow Slake), and is the commoner of the two in the estuaries of the Blyth and Exe.

Tinoporus lævis, Parker & Jones, sp.

Orbitolina lævis, Parker & Jones (1860), Ann. & Mag. Nat. Hist. ser. 3. vol. vi. p. 33. no. 7.

Only a single specimen of *Tinoporus lævis*, and that a somewhat worn and obscure one, has been noticed in the course of these examinations. It was found in the Bo'ness gathering (Frith of Forth), and is probably a dead shell accidentally carried in by the tide from deeper sea. Under these circumstances it has been omitted from the catalogue, pending better evidence of its power of living in brackish water.

Patellina corrugata, Williamson.

Patellina corrugata, Williamson (1858), Rec. For. Gt. Br. p. 47, pl. 3. figs. 86–88.

A considerable number of small specimens of this interesting type occurred amongst the microzoa from Montrose Basin, and a few in the Blyth estuary; elsewhere it has not been noticed in brackish water. Hitherto *Patellina corrugata* has been regarded as a deep-water species, and has been rarely met with on the east coast.

Polystomella striatopunctata, Fichtel & Moll, sp.

Nautilus striatopunctatus, Fichtel & Moll (1803), Testacea Microscopica, p. 61, pl. 9. figs. *a–c*.

The commonest of all Foraminifera inhabiting brackish water. In the Fen district its distribution is curiously irregular, following that of *Rotalia Beccarii* very closely. In two of the western Scottish localities it has not been observed, possibly owing to insufficient quantity of material; but with these exceptions it has been invariably and abundantly present even in the areas furthest removed from the open sea. As before stated, specimens, apparently living, were found in one locality where the water was absolutely fresh; and it existed plentifully in a pool near the river Wear, in which analysis showed only one per cent. of saline constituents. In such cases the shell-wall is exceedingly thin and transparent, and the shells are often of a pale green colour, but otherwise have characters identical with those of marine origin. The entire absence of the type (*P. crispa*), so common almost everywhere in marine gatherings from our shores, is worthy of note. There is but little doubt that the present form is only the depauperated condition of the more robust typical species.

Nonionina asterizans, Fichtel & Moll, sp.

Nautilus asterizans, Fichtel & Moll (1803), Testacea Microscopica, p. 37, pl. 3. figs. *e–h*.

In the estuaries of the Alne, Blyth, Tees, and Scheldt; very rare.

The typical *N. asterizans* is scarcely distinguishable from fine specimens of *N. depressula*, except by the slight deposit of clear shell-substance radiating from the umbilicus. Morphologically it lies between *N. depressula* and *N. stelligera*, the latter having an extreme development of the stellate sutural limbation. Both *N. asterizans* and *N. stelligera* are very rare in the British seas.

Nonionina turgida, Williamson, sp.

Rotalina turgida, Williamson (1858), Rec. For. Gt. Br. p. 50, pl. 4. figs. 95–97.

Montrose Basin; very rare.

A single shell of the still more inflated variety *Nonionina scapha* occurred in the material from the estuary of the Ribble; but it appeared to be a dead specimen, and it has therefore been omitted from the catalogue.

Nonionina depressula, Walker & Jacob, sp.

Nautilus depressulus, Walker & Jacob (*fide* Kanmacher) (1798), Adams's Essays, 2nd ed. p. 641, pl. 14. fig. 33.

The remarks appended to *Polystomella striatopunctata* relative to distribution apply with almost equal force to this species. It is almost invariably abundant in brackish pools.

Notes.

1. In the following Table an attempt is made to show the relative frequency of the various species of Foraminifera on the same plan as that previously adopted with respect to the Entomostraca,—*three* asterisks being placed to the commonest forms, *two* to those occurring frequently but not in any considerable number, and one to those of extreme rarity. In most of the columns these marks indicate with tolerable accuracy the relative distribution of the species; but in a few, either from insufficiency of material or other circumstance, the record must be taken with reservation. The columns headed 9, 11, and 12 (River Ribble, Loch Grunard, and Portree Harbour) are of this category; and that marked D *d* (Scheldt) is not given as in any sense an exhaustive catalogue, but only as a note of the specimens placed in our hands by Mr. E. C. Davison.

2. Column 15, the summary of Mr. Parker's subrecent gatherings from the Fen clay, requires the addition of the following species to make it complete. As none of them have been found living in any of the localities treated of in the present paper, it was thought needless to extend the Table by their insertion:—

Lituola agglutinans, *D'Orb.* *
Spirillina vivipara, *Ehrenb.* *
Lagena caudata, *D'Orb.* **
Nodosaria raphanus, *Linn.* *
—— aculeata, *D'Orb.* *

Uvigerina aculeata, *D'Orb.* *
Virgulina squamosa, *D'Orb.* *
Pulvinulina Karsteni, *Reuss.* **
Nonionina umbilicatula, *Montag.* *
—— granosa, *D'Orb.* **

Subkingdom PROTOZOA.

Class RHIZOPODA.

Order RETICULARIA.

(FORAMINIFERA.)

Types.	Genera and Species.	Clyde. A.	Montrose Basin. B.	Budle Bay. C.	R. Aln (above Alnmouth). E.	R. Coquet (Warkworth Hermitage). F.	R. Wansbeck. G.	R. Blyth. H.	R. Tay (Errol). 1.	Frith of Forth (Bo'ness). 2.	Seaton Sluice. 3.	R. Tyne (Jarrow Slake). 4.	R. Wear (Hylton Dene). 5.	Hartlepool Slake. 6.	R. Tees (near Middlesbro'). 7.	R. Exe (Lympston). 8.	R. Ribble. 9.	Dykes on the Site of Whittlesea Mere. O.	R. Nene (Peterboro'). Q.	R. Cam (Ely). R.	Wroxham Broad. S.	Barton Broad. T.	Hickling Broad and Horsey Mere. U,V.	Somerton Broad. W.	Oulton Broad. Y.	R. Bure (Yarmouth.) Aa.	Breydon Water. Bb.	R. Scheldt (near Antwerp). Dd.	Loch-in-Daal (Islay). 10.	Loch Gruinard (Islay). 11.	Portree Harbour (Skye). 12.	Loch Gilp. 13.	Westport (Ireland). 14.	Summary of Mr. Parker's [illegible] gatherings (see page 305). 15.
Suborder IMPERFORATA.																																		
Family Miliolida.																																		
Cornuspira foliacea, *Phil.*	Cornuspira, *Schultze.*																																	
	foliacea, *Philippi*	...	*	*	...	...	...	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**
	Biloculina, *D'Orb.*																																	
	ringens, *Lamk.*	...	*																															
	depressa, *D'Orb.*	...	...	*	*	...	*	*																										
	elongata, *D'Orb.*	...	...	...	...	...	*	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*								
	Triloculina, *D'Orb.*																																	
	trigonula, *Lamk.*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*							
	oblonga, *Montagu*	...	**	*	*	...	**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*	**	...	...	...	...	...	*	**
Miliola seminulum. *Linn.*	Quinqueloculina, *D'Orb.*																																	
	seminulum, *Linn.*	...	*	**	**	...	**	***	...	*	...	...	...	*	**	...	...	...	...	...	...	*	...	...	...	**	*	*	...	...	*	...	**	
	Candeiana, *D'Orb.*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*														
	subrotunda, *Montagu*	...	*	**	**	...	*	***	...	***	...	...	...	...	**	...	...	**	...	...	...	...	...	...	...	**	...	...	...	...	...	...	...	**
	secans, *D'Orb.*	...	...	*	...	...	*	*	...	...	...	...	...	*	...	...	...	...	...	...	...	...	...	...	...	...	**							
	bicornis, *W. & J.*	...	...	*																														
	fusca, *nov. spec.*	**	...	...	**	**	**	...	...	...	***	...	***	...	*	...	...	...	...	...	...	...	***	...	...	*	...	...	***	***	*	***	***	
	Spiroloculina, *D'Orb.*																																	
	limbata, *D'Orb.*	...	...	*	...	...	...	*																										
Family Lituolida.																																		
Trochammina squamata, *P. & J.*	Trochammina, *P. & J.*																																	
	squamata, *P. & J.*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*				
	inflata, *Montagu*	...	**	*	**	...	**	**	...	...	*	...	**	...	**	...	...	*	...	...	...	...	**	...	...	**	**	...	**	...	...	...	*	**
	macrescens, *nov. spec.*	...	...	...	...	...	...	*	...	...	...	...	**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**	...	**	**	
Lituola nautiloidea, *Lamk.*	Lituola, *Lamk.*																																	
	scorpiurus, *Montfort*	...	...	...	...	...	...	...	...	*																								
	canariensis, *D'Orb.*	**	...	*	**	...	*	*	**	**	*	...	...	...	...	...	...	...	...	...	...	...	**	**	...	...	**	...	...	**	*	**	**	**
Suborder PERFORATA.																																		
Family Lagenida.																																		
Lagena sulcata, *W. & J.*	Lagena, *Walker.*																																	
	sulcata, *W. & J.*	...	**	***	**	*	**	***	...	**	...	...	...	...	...	...	*	...	...	...	...	...	...	**	*	*	**	...	...	...	...	...	*	**
	Lyellii, *Seguenza*	...	*	...	...	...	...	...	...	*																								
	lævis, *Montagu*	...	***	***	**	...	*	*	...	***	...	...	...	...	...	...	*	*	...	...	...	...	...	*	...	**	**	..	...	...	...	...	*	**
	gracillima, *Seguenza*	...	**	**	**	...	*	**	...	**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*	...	...	...	...	...	**	**
	globosa, *Montagu*	...	*	*	?	...	*	*	...	**	...	...	...	...	...	...	*	...	...	*	*	...	...	*	**	*	...	...	...	...	...	...	*	**
	striata, *D'Orb.*	...	**	**	**	...	*	**	...	**	...	...	...	...	...	...	*																	
	semistriata, *Will.*	...	*	**	*	...	*	**	...	...	...	...	...	...	...	...	...	*	...	...	...	...	...	**	...	...	*	...	...	...	...	...	*	***
	distoma, *P. & J.*	...	**	**	**	...	*	*	...	**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**
	marginata, *W. & J.*	...	**	**	*	...	**	**	...	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**
	ornata, *Will.*	...	**	*																														
	pulchella, *Brady*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*						
	squamosa, *Montagu*	...	*	*	...	...	*	**	...	...	...	...	...	...	...	...	...	*	...	...	...	...	...	...	...	*	...	...	...	...	...	...	...	**
	melo, *D'Orb.*	...	*	...	*	...	...	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*	....	...	...	...	...	...	**
Nodosarina raphanus, *Linn.*	Glandulina, *D'Orb.*																																	
	lævigata, *D'Orb.*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*						
	Nodosaria, *Lamk.*																																	
	scalaris, *Batsch.*	...	*	*	...	...	...	*	...	*																								
	Dentalina, *D'Orb.*																																	
	communis, *D'Orb.*	...	*	...	*	...	...	...	...	**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*
	guttifera, *D'Orb.*	...	...	...	...	...	...	*	...	*																								
	Vaginulina, *D'Orb.*																																	
	legumen, *Linn.*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*	
	Marginulina, *D'Orb.*																																	
	glabra, *D'Orb.*	...	*																															
	Cristellaria, *Lamk.*																																	
	rotulata, *Lamk.*	...	...	...	...	...	...	*																										
	crepidula, *F. & M.*	...	...	...	...	...	*	*																										
Polymorphina lactea, *W. & J.*	Polymorphina, *D'Orb.*																																	
	lactea, *W. & J.*	...	...	*	...	...	...	...	...	...	...	...	...	...	...	...	...	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**
	communis, *D'Orb.*	...	...	...	*	...	...	*																										
	oblonga, *Will.*	...	...	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*							
	compressa, *D'Orb.*	...	**	**	...	...	**	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**							
Uvigerina pygmæa, *D'Orb.*	Uvigerina, *D'Orb.*																																	
	irregularis, *Brady*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*																	
Family Globigerinida.																																		
Orbulina universa, *D'Orb.*	Orbulina, *D'Orb.*																																	
	universa, *D'Orb.*	...	...	*																														
Globigerina bulloides, *D'Orb.*	Globigerina, *D'Orb.*																																	
	bulloides, *D'Orb.*	...	*	...	...	...	...	*	...	...	...	...	*	...	...	...	...	...	*	...	...	...	...	*	...	...	...	...	...	...	*	...	**	**
Textularia agglutinans, *D'Orb.*	Textularia, *Defrance.*																																	
	sagittula, *Defrance*	...	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*	
	variabilis, *Will.*	...	*	...	...	...	...	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	***
	globulosa, *Ehrenb.*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*	
	pygmæa, *D'Orb.*	...	*																															
	difformis, *Will.*	...	*																															
	Gaudryina, *D'Orb.*																																	
	pupoides, *D'Orb.*	...	*																															
	Verneuilina, *D'Orb.*																																	
	spinulosa, *Reuss*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*	
	polystropha, *Reuss*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*	...	...	...	...	...	...	...	...	...	...	...	...	*	...	...	...	...	
Bulimina Presli, *Reuss*	Bulimina, *D'Orb.*																																	
	pupoides, *D'Orb.*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*	
	marginata, *D'Orb.*	...	*	...	...	...	...	*	...	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	ovata, *D'Orb.*	...	**	***	**	...	**	*	...	**	...	...	...	...	...	...	...	...	...	...	...	...	...	*	...	...	...	...	...	...	...	...	**	
	elegantissima, *D'Orb.*	...	*	...	...	...	...	...	...	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**
	Virgulina, *D'Orb.*																																	
	Schreibersii, *Czjzek*	...	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**
	Bolivina, *D'Orb.*																																	
	punctata, *D'Orb.*	...	*	**	*	...	**	*	...	**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*
	plicata, *D'Orb.*	...	*	*	...	...	...	*	...	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Discorbina turbo, *D'Orb.*	Discorbina, *P. & J.*																																	
	rosacea, *D'Orb.*	...	*	*	...	...	**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*
	globularis, *D'Orb.*	...	...	*	*	...	**	**	**	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**	...	...	*
Planorbulina farcta, *F. & M.*	Planorbulina, *D'Orb.*																																	
	mediterranensis, *D'Orb.*	**	*	**	**	...	*	**	...	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*	*	...	...	...	*	...	*	**
	Truncatulina, *D'Orb.*																																	
	lobatula, *Walker*	...	*	*	**	...	**	***	...	**	...	*	...	**	*	...	...	...	...	...	...	...	...	...	*	*	...	...	...	...	...	...	...	
	refulgens, *Montfort*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*	...	...	...	...	...	...	...	...	...	...	*
Pulvinulina repanda, *F. & M.*	Pulvinulina, *P. & J.*																																	
	auricula, *F. & M.*	...	...	*																														
Rotalia Beccarii, *Linn.*	Rotalia, *Lamk.*																																	
	Beccarii, *Linn.*	...	*	**	**	**	*	**	...	**	**	**	...	*	**	***	**	*	...	*	...	...	...	...	**	***	***	*	...	...	...	...	***	***
Patellina concava, *Lamk.*	Patellina, *Will.*																																	
	corrugata, *Will.*	...	**	...	...	...	...	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*
Family Nummulinida.																																		
Polystomella crispa, *Linn.*	Polystomella, *Lamk.*																																	
	striato-punctata, *F. & M.*	**	***	**	***	***	***	***	**	***	***	***	***	***	***	***	***	**	...	...	...	**	...	...	*	***	***	**	***	...	**	...	***	***
	Nonionina, *D'Orb.*																																	
	asterizans, *F. & M.*	...	...	...	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	***
	turgida, *Will.*	...	*	...	*	...	...	*	...	...	...	...	...	...	*	...	...	...	...	...	...	...	...	...	...	...	...	*	...	...	...	...	...	*
	depressula, *W. & J.*	**	*	**	*	**	**	***	**	**	***	**	...	***	***	**	*	**	...	**	*	...	...	*	**	**	***	...	...	...	**	...	**	***

EXPLANATION OF PLATES IV.–XII.

Plate IV.

Fig. 1. *Cypris ventricosa* (female ?), seen from the left side.
Fig. 2. The same, seen from below. } ×20.
Fig. 3. The same, seen from behind.
Fig. 4. *Cypris tumefacta* (female ?), seen from the left side.
Fig. 5. The same, seen from above.
Fig. 6. The same, seen from the front.
Fig. 7. *Cypris fretensis* (female ?), seen from the left side. } ×40
Fig. 8. The same, seen from below.
Fig. 9. The same, seen from behind.

Plate V.

Fig. 1. *Candona diaphana* (male ?), seen from the left side.
Fig. 2. The same, seen from above. } ×50.
Fig. 3. The same, seen from below.
Fig. 4. *Candona hyalina* (male), superior antenna.
Fig. 5. The same, inferior antenna. } ×210.
Fig. 6. The same, mandible and palp.
Fig. 7. The same, palp of second jaw (female).
Fig. 8. The same, second jaw and palp (male). ×84.
Fig. 9. The same, postabdominal ramus. ×120.
Fig. 10. The same, glandula mucosa (male). ×210.
Fig. 11. The same, copulative organs (male). ×84.

Plate VI.

Fig. 1. *Metacypris cordata* (female ?), seen from the left side.
Fig. 2. The same, seen from above.
Fig. 3. The same, seen from below.
Fig. 4. The same, seen from the front.
Fig. 5. The same, right valve, from inside.
Fig. 6 The same, left valve, from inside.
Fig. 7 *a*. The same, right valve, superior margin, seen from above. } ×84.
Fig. 7 *b*. The same left valve, " " " "
Fig. 8 *a*. The same, left valve, inferior margin, seen from below.
Fig. 8 *b*. The same, right valve, " " "
Fig. 9 *a*. The same, right valve, posterior margin, seen from behind.
Fig. 9 *b*. The same, left valve, " " " "

Plate VII.

Fig. 1. *Polycheles Stevensoni* (female), seen from the left side.
Fig. 2. The same, seen from above.
Fig. 3. The same, seen from below.
Fig. 4. The same, seen from the front. } ×40.
Fig. 5. The same (male ?), seen from the left side.
Fig. 6. The same, seen from above.
Fig. 7. The same, lucid spots. ×100.
Fig. 8. *Candona compressa* (female), seen from above. } ×40.
Fig. 9. The same, seen from the right side.
Fig. 10. *Goniocypris mitra*, seen from the left side.
Fig. 11. The same, seen from above. } ×84.
Fig. 12. The same, seen from below.
Fig. 13. The same, seen from the front.

Fig. 14. *Cypridopsis Newtoni* (female), seen from the left side.
Fig. 15. The same, seen from above.
Fig. 16. The same, seen from the front.
} ×40.

Plate VIII.

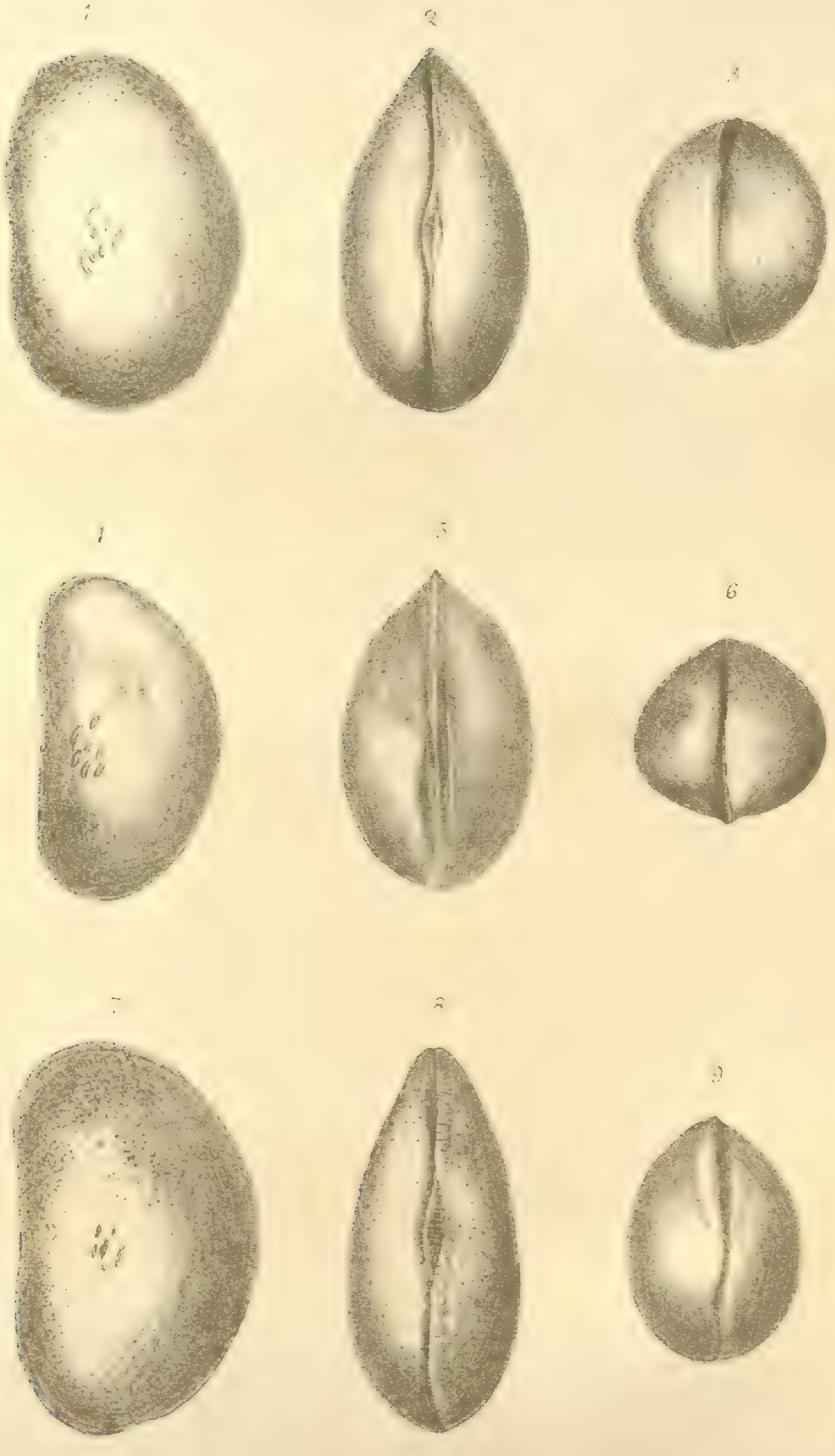
Fig. 1. *Loxoconcha pusilla*, seen from the left side.
Fig. 2. The same, seen from above.
Fig. 3. The same, seen from the front.
Fig. 4. *Argillœcia aurea*, seen from left side.
Fig. 5. The same, seen from below.
} ×84.
Fig. 6. *Cytheridea torosa* (male), seen from the left side.
Fig. 7. The same, seen from above.
} ×40.
Fig. 8. *Cythere fidicula*, seen from the left side.
Fig. 9. The same, seen from above.
Fig. 10. The same, seen from below.
Fig. 11. The same, seen from the front.
} ×84.

Plate IX.

Fig. 1. *Cytheridea inæqualis*, seen from the right side.
Fig. 2. The same, seen from above.
Fig. 3. The same, seen from below.
Fig. 4. The same, seen from the front.
} ×40.
Fig. 5. *Candona hyalina* (male), seen from the left side.
Fig. 6. The same, seen from above.
} ×30.
Fig. 7. The same (female), seen from the left side.
Fig. 8. The same, seen from above.
Fig. 9. *Candona Kingsleii* (male), seen from the left side.
Fig. 10. The same, seen from above.
Fig. 11. *Candona Kingsleii* (female), seen from the left side.
Fig. 12. The same, seen from above.
Fig. 13. *Candona candida*, var. *tumida* (female), seen from the right side.
Fig. 14. The same, seen from above.
Fig. 15. The same, seen from behind.
} ×40.

Plate X.

Fig. 1. *Cytherura propinqua*, seen from the left side.
Fig. 2. The same, seen from above.
Fig. 3. *Loxoconcha fragilis*, left valve, seen from outside.
} ×84.
Fig. 4. *Polycheles Stevensoni* (female), superior antenna.
Fig. 5. The same, inferior antenna.
Fig. 6. The same, mandible.
Fig. 7. The same, first maxilla.
Fig. 8. The same, second maxilla.
Fig. 9. The same, first foot.
Fig. 10. The same, second foot.
Fig. 11. The same, third foot.
Fig. 12. The same, abdominal ramus.
Fig. 13. The same, copulative organs of male.
Fig. 14. The same, infero-posteal angle of shell, with jointed hairs.
} ×210.

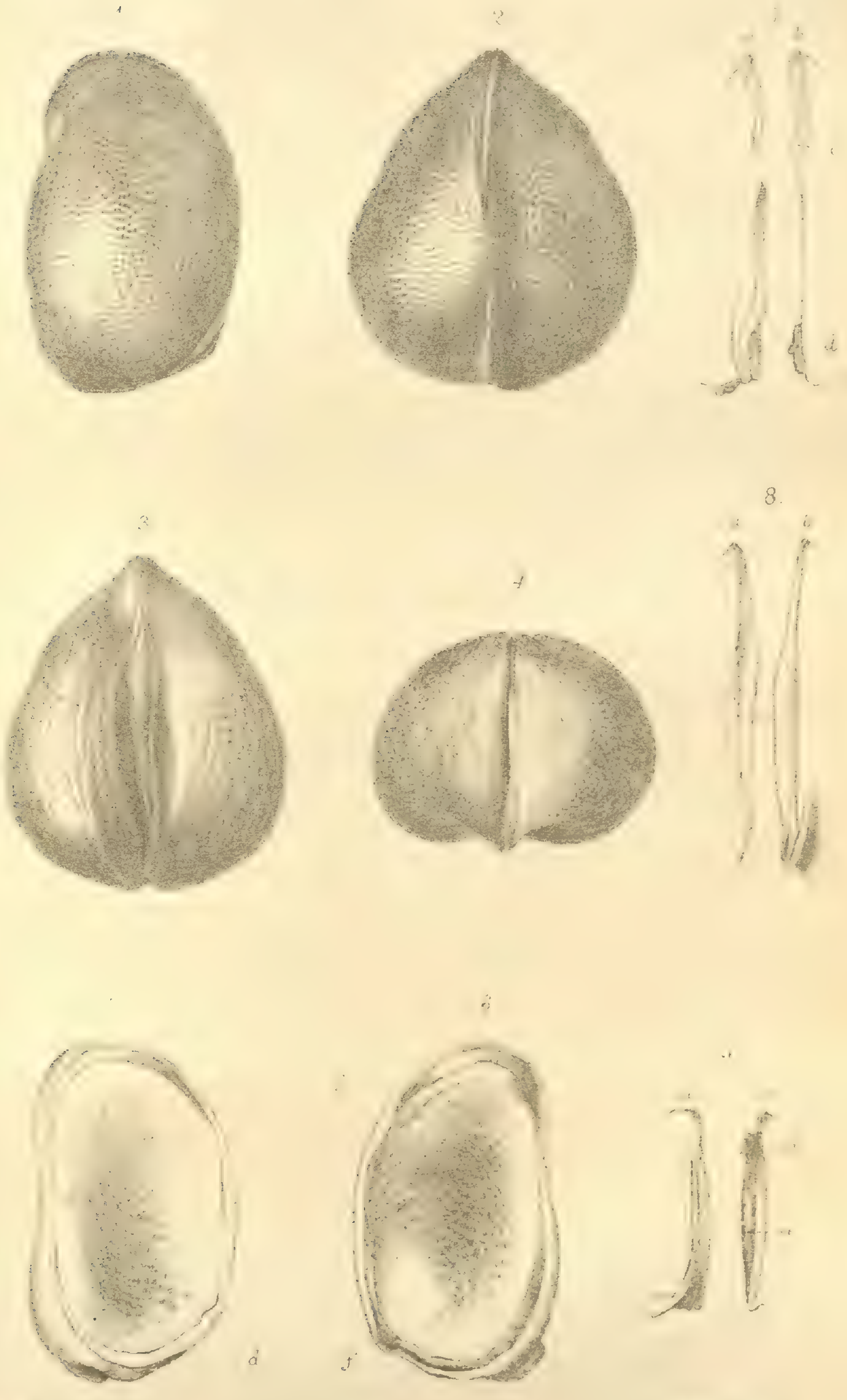


G. S. Brady del. et lith.

W. West imp.

G. S. Brady del. et lith.

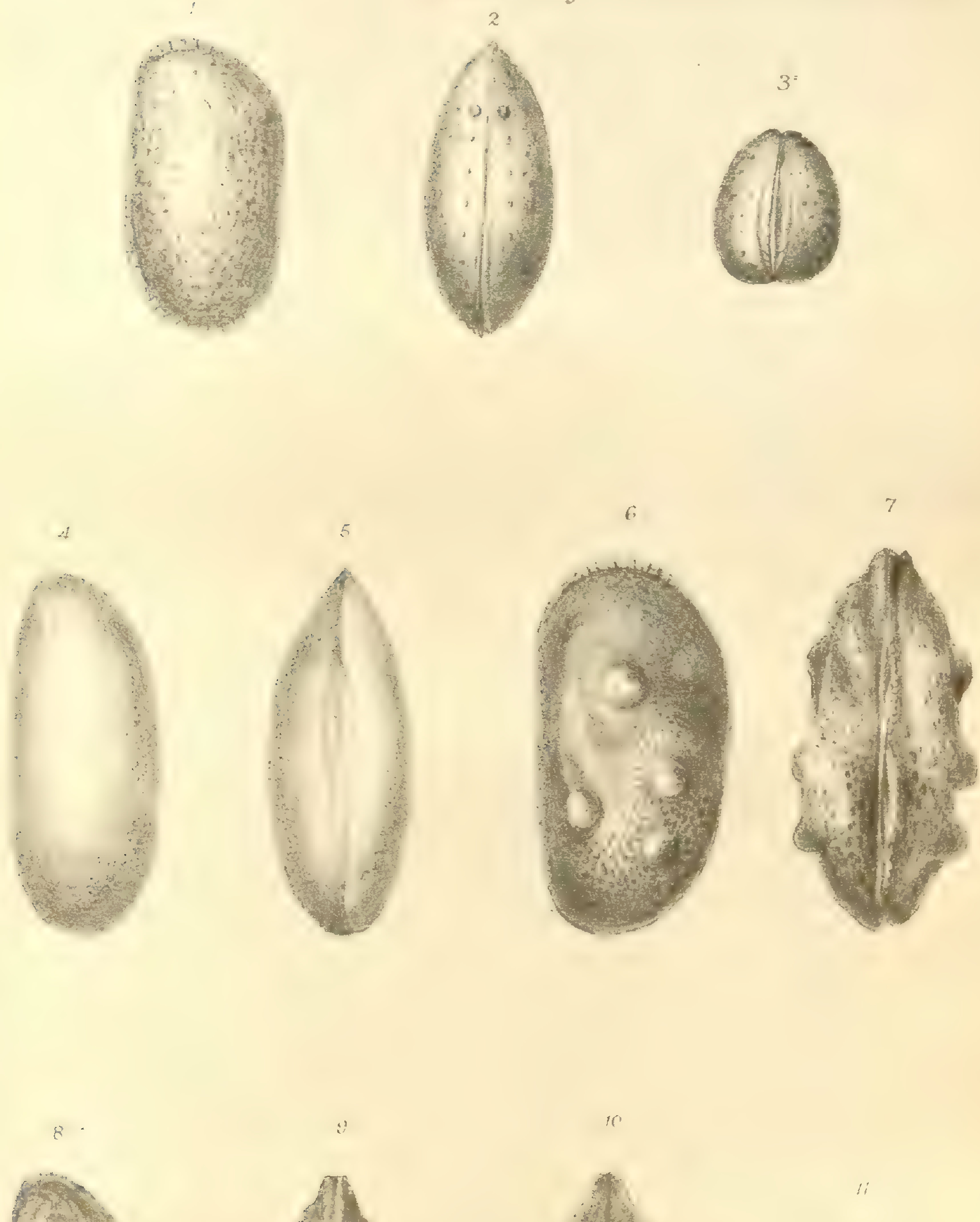
W. West imp.



Brady del. et lith. W West

G. S. Brady del. et lith.

W. West imp.



G.S. Brady del. et lith.

W West imp.

G. S. Brady del. et lith. W. West imp.

G. S. Brady del. et lith.

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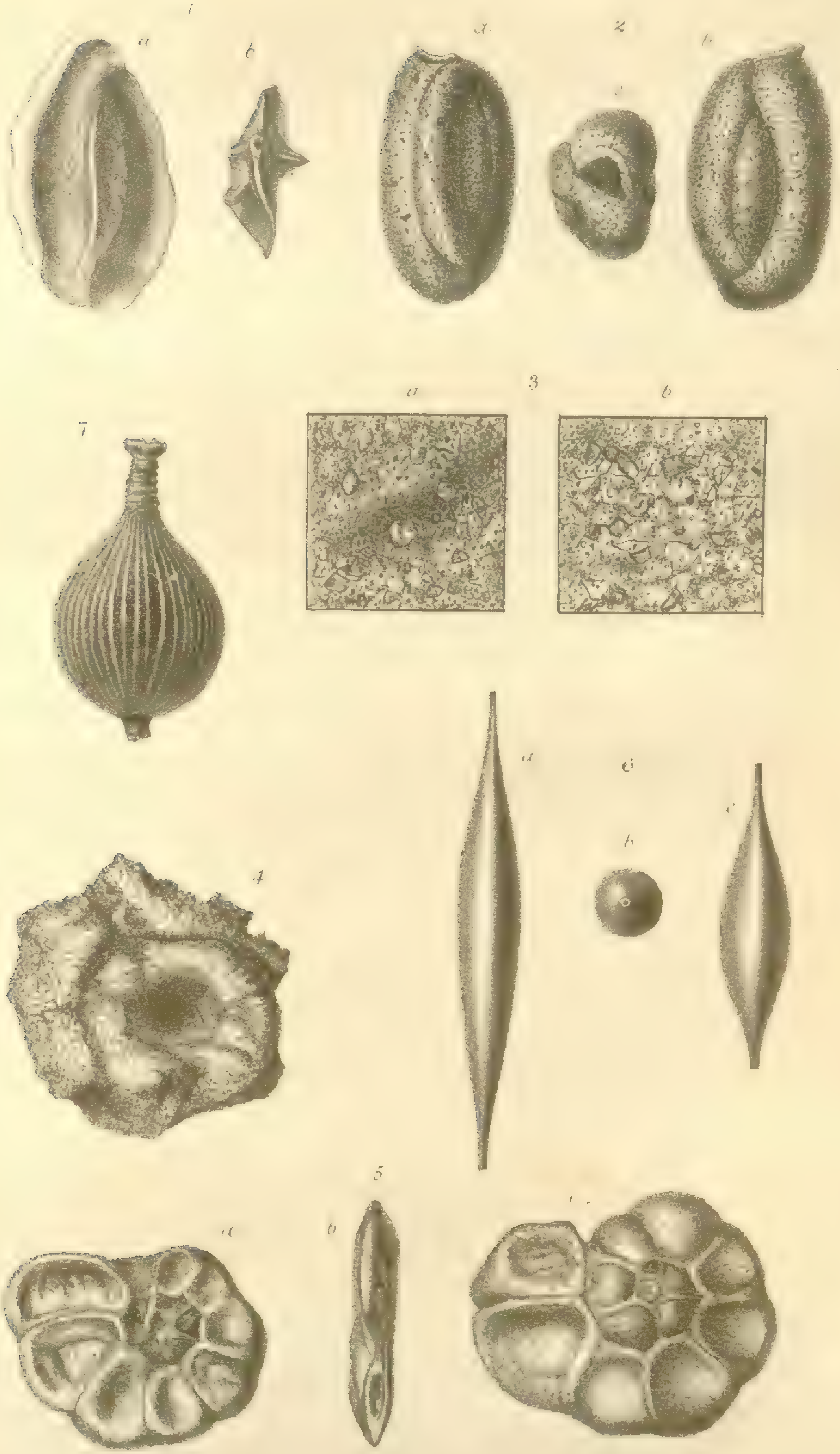

A. T. Hollick del. et lith.

W. West imp.

A. T. Hollick del. et lith.

W. West imp.

PLATE XI.

Fig. 1. *Quinqueloculina Candeiana*, D'Orb., × 95 diams.: *a*, lateral aspect; *b*, end view, showing the aperture.

Fig. 2. *Quinqueloculina fusca*, n. sp., × 95 diams.: *a* & *c*, lateral aspects; *b*, end view, showing aperture.

Fig. 3. Portions of the test of the same, more highly magnified, × 200 diams.: *a*, portion of the test mounted in Canada balsam and viewed by transmitted light; *b*, similar fragment decalcified by means of strong acid before mounting, the chitinous matrix alone remaining.

Fig. 4. *Trochammina squamata*, P. & J., × 40 diams.

Fig. 5. *Trochammina inflata*, var. *macrescens*, × 90 diams.: *a* & *c*, lateral aspects; *b*, peripheral aspect, showing aperture.

Fig. 6. *Lagena gracillima*, Seguenza, × 100 diams.: *a* & *c*, lateral views; *b*, end view, showing one of the apertures.

Fig. 7. *Lagena Lyellii*, Seguenza, × 95 diams.

PLATE XII.

Fig. 1. *Lagena pulchella*, Brady, × 65 diams.: *a*, lateral aspect; *b*, end view, showing aperture.

Fig. 2. *Dentalina guttifera*, D'Orb., × 115 diams.

Fig. 3. *Marginulina glabra*, D'Orb., × 115 diams.

Fig. 4. *Textularia globulosa*, Ehrenberg, × 115 diams.: *a*, lateral aspect; *b*, end ditto.

Fig. 5. *Gaudryina pupoides*, D'Orb., × 115 diams.: *a*, lateral aspect; *b*, end ditto.

Fig. 6. *Verneuilina spinulosa*, Reuss, × 95 diams.: *a*, view of one of the three faces; *b*, general lateral aspect perpendicular to one of the carinæ; *c*, end view, showing the aperture.

Fig. 7. *Bolivina plicata*, D'Orbig., × 95 diams.: *a*, lateral aspect; *b*, end view and aperture.

Fig. 8. *Rotalia Beccarii*, Linn., brackish variety, × 55 diams.: *a* & *b*, superior and inferior lateral aspects; *c*, peripheral aspect.

XXVII.—*Notes on Anchoring Sponges* (*in a Letter to* Mr. Moore). By Dr. J. E. GRAY, F.R.S. &c.*

MY DEAR MOORE,

Mrs. Gray, who was very much pleased with the additions to and alterations of the Museum, since she saw it five years ago, has not been unmindful of the wish you expressed to have a specimen of the globular anchor-sponge, from the coast of Portugal, which Mr. Kent has named *Pheronema Grayi*, to exhibit during the meeting of the British Association.

On speaking to Mr. Kent, he placed a specimen at Mrs. Gray's disposal for the purpose you wished. As the specimen, like all the others brought home from Portugal, and like those of *Holtenia Carpenteri* from the North Sea, had the

* Read at the Biological Section of the British Association, Sept. 1870.

anchoring-filaments in a wisp, and all entangled together—and knowing that Mr. Laughrin had unravelled for me the fibres of a specimen of *Holtenia Carpenteri* which is now in the collection of Miss Saul, of Bow, and had shown that they form a ring-like series of tufts round the lower end of the body of the sponge, giving it quite a different appearance from the representations of it given by Prof. Wyville Thomson, I placed the Portuguese specimen in the hands of your son-in-law, Mr. Edward Gerrard, junr., and requested him to try to unravel the very long anchoring-filaments; and I think you will allow that he has been very successful and has made a very beautiful and most interesting preparation of it, and most important in a scientific point of view, as it shows very distinctly the character which separates the Portuguese from the North-Sea species; that is to say, that, instead of having the anchoring-filaments in twenty-five or twenty-six tufts from the base of the sponge, they arise separately from almost the entire surface of it. These long filaments, like those of *Euplectella*, are called anchoring-filaments, because they are spread out in the mud and hold the sponge in its place. For this purpose they have at the end of the filament a whorl of three or four hooks, like a grapnel, and a few scattered recurved hooks above them.

There appear to be several species of Sponges allied to the one from Portugal; and I should be inclined to form them into a family, which may be called *Pheronemadæ*. They are peculiar in having an ovate, globular, or purse-like body, with a large internal cavity, and outer walls formed of hexradiate spicules placed side by side, producing a tessellated surface formed of stars.

The first account of a sponge of this kind was by Dr. Leidy, who described a specimen from Santa Cruz, presented by Dr. Griffith to the Museum of the Academy of Natural Sciences of Philadelphia, in the Journal of that Academy for 1860; in the same Journal for 1869 he gave it the name of *Pheronema Annæ*, after his wife; and in the 'American Naturalist' for March 1870, he gave figures of the specimen and of its spicules, one of the figures showing the anchor-termination. This species has the anchor-filaments in twenty-five distinct tufts, but they are not so long as the length of the sponge; and there are no rings of cilia on the upper surface near the opening of the internal cavity; but this may be occasioned by the state of the specimen.

Dr. Carpenter and Prof. Wyville Thomson discovered in the deep-sea dredging in the North Sea a beautiful sponge of this family, which Prof. Thomson has described and figured in the

'Proceedings' and 'Transactions' of the Royal Society, under the name of *Holtenia Carpenteri*. This sponge is very like the one described by Dr. Leidy, but differs from it in the tufts of filaments surrounding the base being very much longer, longer than the length of the body of the sponge; and the upper surface of the sponge has a series of very fine spines round the edge of the oscule, and another, similar series on the upper part of the body, at some distance from the former.

Prof. Barboza du Bocage, the Director of the Museum at Lisbon, obtained some specimens, from the coast of Portugal, of a sponge which he considered to be a globular variety of *Holtenia Carpenteri*.

Mr. Kent, who went out for the purpose of dredging on the coast of Portugal in Mr. Marshall-Hall's yacht 'Norna,' obtained several specimens of this sponge, which he thought, like M. Bocage, was the same as the one from the North Sea. On my inspecting them in company with him, however, we were satisfied that it was a distinct species; and in the 'Annals and Magazine of Natural History' for August 1870, p. 182, Mr. Kent has described it under the name of *Pheronema Grayi*; but one very important character he does not seem to have recorded (which is not extraordinary, as it is not distinctly visible in the sponge in the state in which he examined it, but has become much more distinct in the specimen that Mr. Gerrard has prepared)—that is to say, that, instead of the filiform anchoring-spicules being in tufts at the hinder end of the body, they arise separately from all parts of the surface of the body, except from a small broad nude band round the oscule. This being the case, I think that it forms a distinct genus, for which I propose the name of *Callisphæra*. This position of the anchoring-filaments gives the sponge much the appearance of an old man's head with long silvery locks.

Dr. Oscar Schmidt, of Grätz, in his work just published on the Sponges of the Atlantic, describes an *Holtenia* under the name of *H. Pourtalesii*, from Florida, and indicates a second species from the same place, under the name of *Holtenia saccus*. Both these are small bag-like species, and they appear to be entirely deficient of any slender filiform anchoring-spicules, but have the surface of the body scattered over with spreading, moderately long, filiform spines. This form certainly indicates a very distinct group from all the species above noticed, and I should be inclined provisionally to designate it by the name of *Vazella*.

Prof. O. Schmidt, in the same work, describes a sponge of quite a different structure, but of much the same form, divided into several tubercles below, and probably belonging

to the family Tethyadæ, which, like the *Holteniæ*, are free Sponges, only attached by numerous long filiform anchoring-spicules which arise from the hinder part of the body. He calls it *Tetella polyura*; but it has little in common with the other *Tetellæ*, and I think it should be distinguished by the name of *Polyurella Schmidtii*.

I am in hopes that, when the results of the dredging on the coast of Portugal are distributed, the specimen which you now exhibit will become the property of the Derby Museum; but I cannot at present assure you of the donation.

I am, my dear Moore,
Yours very sincerely,
J. E. Gray.

British Museum, Sept. 10, 1870.

XXVIII.—*Description of a new Species of Pheasant from the Province of Sechuen, China.* By D. G. Elliot, F.L.S., F.Z.S., &c.

Phasianus elegans.

Mas. Capite colloque viridibus, sub certa luce cyaneo nitentibus; dorso rufo, plumis viridi terminatis; scapularibus dorso concoloribus (parte mediana nigra), albo transfasciatis; uropygio virescenti-cinereo, plumis late viridi terminatis, nigro et albo transfasciatis; plumarum omnium parte basali alba: pectore superiore abdomineque latissime viridibus; hypochondriis et pectoris lateribus castaneis, plumis omnibus saturate cyaneo terminatis: tectricibus supracaudalibus læte aurantiacis, viridi-cinereo lavatis: tectricibus subcaudalibus brunnescenti-nigris, rubro terminatis: cauda saturate castanea, late nigro transfasciata: pedibus plumbeis, cano pallide tinctis: plaga orbitali scarlatina; macula pone oculos viridi.

Head and neck green, with bluish reflections; back red, each feather tipped with green. Scapulars, like the back, with black centres crossed with diagonal white bars. Rump greenish grey, with a broad mark of emerald-green near the tip, succeeded by a narrower one of black, this followed by an irregular one of white; base of feathers blackish. Upper part of breast and abdomen rich emerald-green. Flanks and sides of breast chestnut-red, each feather tipped with dark blue, the feathers becoming rich purple as they approach the centre of the breast, and those next to the abdomen have their inner webs green. Upper tail-coverts bright orange-red, with the greenish grey of the rump-feathers showing through in the centre. Under tail-coverts brownish black, tipped with red. Tail deep chestnut-red, crossed with broad bars of black.

Legs and feet lead-colour inclining to flesh-colour. Bare skin of face scarlet, with a patch of green feathers under and behind the eye.

Two living examples of this new species were lately sent to England among a number of other pheasants of various species from the province of Sechuen in China, somewhere near its south-western border, and deposited in the gardens of the Zoological Society, in Regent's Park. It is to the exertions of Mr. Stone, who has succeeded in bringing to Europe many of the rarer species of this family, that we are indebted for the opportunity of being able to describe this new form. The specimens are both males, and, although now moulting, are in very good condition, but very wild, and endeavour to hide from all who approach their inclosure.

In its geographical distribution this new species appears to be intermediate between the *P. decollatus*, lately described by Mr. Swinhoe, from eastern Sechuen, and the *P. Sladeni*, from Yunan, mentioned in the manuscript notes of Mr. Anderson, the present curator of the Calcutta Museum. The *P. elegans* might be supposed, from its appearance, to be a hybrid between *P. versicolor* and *P. colchicus*; but, unfortunately for such an hypothesis, neither of these species is found anywhere near the locality inhabited by the present one, and consequently a hybrid between them in Sechuen is simply impossible. The *P. elegans* differs from all other pheasants with which I am acquainted, in its red mantle bordered with green on the tip of each feather, in its greenish-grey rump, and in the green breast restricted almost to a median line. These are the prominent differences; but there are various minor ones also, while the general distribution of the colours of its plumage is very different from that of all other members of this family.

This bird furnishes one of the missing links (mentioned in my communication to the Zoological Society lately published upon some other new pheasants) forming the chain of descent from *P. Shawii* through the various other forms now known to us. But very few more are required to enable us to trace the line of descent without any interruption. It is to be hoped that, as the exact locality of the *P. elegans* is well known, we may be able to procure females and have them transmitted to Europe, and thus preserve and perpetuate the species. Although the female is not known to us, I cannot doubt that it would resemble in general appearance the hen of *P. colchicus*, from which also the female of *versicolor* only differs in having a greenish shade, observable in certain lights, upon its plumage. In size the present species is about equal to the ordi-

nary *colchicus*. I have not been able to give measurements, as they are very difficult to obtain from live birds not at all tame. The voice of *P. elegans* is harsh and guttural, very different from that of any of its relatives.

XXIX.—*Some Facts towards a Life-History of* Rhipiphorus paradoxus. By T. Algernon Chapman, M.D., Hereford.

[Plate XVI.]

Before recording my own observations on *Rhipiphorus*, I desire to congratulate Mr. Murray on his having confirmed the observations of the late Mr. Stone, and on his having retracted all the doubts that he had cast on the credibility of the history of *Rhipiphorus* as set forth by that observer.

I am, however, much astonished when he further owns that the inhabitants of his doubly tenanted cells of last year were not the *pupæ* of *Rhipiphorus* as he described them*, but the *larvæ*; and doubtless also their fellow inhabitants, described by him as injured wasp-pupæ, were in reality the partially devoured wasp-larvæ. Now, had he told us that these were larvæ, and not pupæ, there had been no room for any difficulty such as was raised by Mr. Murray. Nay, the very basis of his attack on Mr. Stone would have been but a confirmation of the record of that observer, had Mr. Murray himself not committed such a singular error of observation. There was another instance of the confusion of the terms larva and pupa in Mr. Murray's first paper, which I did not previously refer to, as I had supposed it to be merely a *lapsus calami*, and which Mr. Murray accepted as such, when it was suggested to be so by Mr. Smith. But it now appears that Mr. Murray did both in thought and in observation, as well as on paper, confuse larvæ and pupæ together.

Passing by his observation of the egg of *Rhipiphorus*, I would merely object to such extraordinary ideas of development as Mr. Murray puts forth when he describes the supposed egg as struggling into life at the head, still egg at the base. In his further statement that the egg-shell becomes the first skin of the larva, I believe that he might quote the authority of Newport in the case of the larva of *Meloë*; but in this in-

* Mr. Murray's words are,—"In three instances I found two pupæ in the same cell, a wasp-pupa and a *Rhipiphorus*-pupa—a fact which seems to me to be conclusive against the idea of the one feeding on the other. They must have been hatched in the same cell, bred lovingly as larvæ in the same cell, and undergone their metamorphoses in the same cell." (Ann. & Mag. Nat. Hist. Nov. 1869, p. 349.)

stance, even, I have seen what I believed to be the egg-shell after the larva was hatched. I have seen the egg-shells of many Diptera, of *Musca vomitoria*, for example; I select this as one of the most likely to fulfil Mr. Murray's hypothesis; and I have met with no instance in which an empty egg-shell was not discoverable. In the case of the wasp I have easily made out the following facts.

The newly hatched grub does not creep out of an egg-shell, but casts it as a very delicate pellicle. It does not completely leave it, however, but retains its attachment to the cell-wall by its hinder segments remaining in a portion of the egg-shell, which is firmly attached to the cell-wall; and a considerable portion of the egg-shell may often be seen closely applied to the ventral aspect of the last segments of the larva. The grub casts its skin four times afterwards; so that there are five stages or sizes of larvæ. In the first the jaws are destitute of brown corneous tips; afterwards the larvæ are only distinguishable by their size. I have seen the cast skin between each stage; it is always accompanied by the linings of the tracheæ, and a short lining is drawn out of the mouth. Unlike most other larvæ, in moulting, the head-covering is not cast as a complete corneous plate, but a mere skin is cast, as from the rest of the body, the only corneous portions being the brown jaw-extremities, which are very distinct in each cast skin except the first, and serve readily to distinguish to which moult the skin belongs. All these are very slight, insignificant pellicles, except the last one and the one that is cast on assuming the pupa-state. The greatest proportion of its growth is made by the larva after it has assumed its last skin. I have examined the black deposit both before and after it is deposited; and I find in it no portions of insects of any size, though there are many minute particles that may be bits of chitine. It is, in fact, the effete material of the grub stored up during all its existence; the portions of insects found by Mr. Murray must have been the cast skins of the grub itself. I am satisfied that the grubs are fed by the wasps with only fluid material: though the grubs work their jaws actively, they have very little (no?) power of biting or chewing. The larvæ of the hornet make a great noise by striking and scratching the walls of their cells with their expanded jaws. I take this to be a call for food. The black material is evacuated just before the grub begins to spin its silken covering; and this is the only time at which its alimentary canal is emptied. This is sufficiently proved by the store of black matter in the grub's interior increasing in quantity with the growth of the grub, and by the anal extremity of the grub being always enveloped in a cast skin; so

that it is impossible to suppose that the wasps have removed any thing. Excepting, then, the amount of excretion in the form of vapour, it follows that the wasp-grubs, as well as *Rhipiphorus* and other parasites, actually feed upon an amount of material of only their own bulk.

When the alimentary canal is emptied, the larva commences to spin its silken covering; and now it is far from being such an inert larva as it has previously been: it moves its head actively to and fro to spin the silken dome, and passes its head far down the side of the cell-wall, to cover it with silk. Further, now its last cast skin is buried beneath the black deposit, it has no hold of the base of the cell by its anal segments; and being kept from falling out by the silken covering, it turns on itself so as to be quite folded at its middle; and I have frequently found such a larva completely reversed in the cell. Now there are two facts that prove, I think, that this reversal is not an accident, but the normal procedure of every wasp-grub:—first, that though I have found a number of grubs so reversed at this stage, I find none so at further advanced stages, as would be the case were it an accident; and, secondly, although the silken dome and lining extends with any strength only for about a quarter of an inch down the cell, it extends almost to its base in a slighter form; and in the case of *Vespa norvegica*, I find a strong silken lining quite to the base of the cell.

I have already remarked that the wasp-grub has little more than its own bulk of food: this remark is equally applicable to both solitary and social bees and wasps. In the case of the bees, Mr. Murray will find this more difficult to believe, because the food is not animal, but vegetable. In the case, for example, of *Megachile*, the larva eats its store of pollen-bread, evacuates a few brown-black pellets (less in quantity than the black deposit of the wasp), spins a very thick and strong silken cocoon, and, after a rest of about ten months, completes its transformations, and emerges a bee of about the size of the original mass of pollen. Air-cavities within and a thick coating of hair, of course, aid in giving the appearance of no bulk having been lost.

On August 4, 1870, I succeeded in obtaining a nest of *Vespa vulgaris* that was well tenanted by *Rhipiphorus paradoxus*, and easily ascertained that the larva of *Rhipiphorus* eats that of the wasp after the latter has spun up, and that the *Rhipiphorus* completes its transformations only a day or two after the surrounding wasps. I examined this nest with some care within a few hours after it was taken, and, though I observed many small larvæ, I failed to find any eggs. I was

very fortunate in obtaining, a few days afterwards, two small nests which contained abundance of *Rhipiphori*, for the purpose of searching for the egg. I examined these almost immediately after they were taken, and ascertained a point in the history of *Rhipiphorus* that renders it parallel with those of *Meloë* and *Stylops*; and though my first observations had cleared up most of the disputed points in its history, these opened up a fresh field for investigation. My observations will perhaps be more intelligible if I throw them into the form of a life-history of the beetle; and this arrangement will show more clearly what points require further elucidation.

Rhipiphorus, then, doubtless lays her eggs somewhere; but where, I am unable to tell. I first take up the history with the young larval *Rhipiphorus* at large in the wasps' nest, in a form not unlike that of the young larva of *Meloë*. It was in examining the first nest, that I met with a solitary specimen of the larva in this stage. I examined it under the microscope, but neither figured it nor wrote a description of it at the time. Though it will be obvious, as I proceed with the history, that this was undoubtedly the young larva of *Rhipiphorus*, and though the idea of such a possibility occurred to me at the time (and, in writing to Prof. Westwood on the point, I even suggested it), still I did not think it was so, and, not having too much time to spare, I passed it by. I am able nevertheless to give a tolerably accurate account of it. It is a little black hexapod, about $\frac{1}{50}$ inch (·5 millim.) in length, and $\frac{1}{120}$ inch in breadth, broadest about the fourth segment, and tapering to a point at the tail; a triangular head with a pair of three-jointed antennæ nearly as long as the width of the head, with legs very like those of *Meloë*-larvæ; the tibiæ ending in two or three claws, which supported and were obscured by a large transparent pulvillus or sucker of about twice their length; this was marked by faint striæ radiating from the extremity of the tibia, giving it much the aspect of a lobe of a fly's proboscis. Each abdominal segment had a very short lateral spine pointing backwards; the last segment terminated by a large double sucker similar to those of the legs; and the little animal frequently stood up on this, and pawed the air with its feet, as if in search of some fresh object to lay hold of. This little larva finds a wasp-grub suited to its taste, and makes its way into its interior. I believe, from once or twice finding a trace of a mark there, that it enters about the back of the second or third segment. But I do not know this, nor at what age of the wasp-larva it does so. I have, however, succeeded in finding the larva of *Rhipiphorus* within that of the wasp, before the latter had spun up. As-

suming that the wasp-larva lives six days in its last skin before spinning up, I should guess that the youngest of these had still two or three days' feeding to do. The *Rhipiphorus*-larvæ were but a little way beneath the skin of the back, about the fourth and fifth segments, and indifferently on either side. The smallest of these was $\frac{1}{16}$ inch in length, and, except its smaller size, was precisely like the larger ones I am about to refer to, having the same head, legs, plates, &c. These were of the same size as those of the larger larvæ, the difference in size of the latter being due to the expansion of the intermediate colourless integument. I ought perhaps to add that the nest in which I found these was not examined until twelve hours after I had taken it. It had also been so much blockaded by boys stoning it, that the wasps had not had free access to and from it for some time.

I next take up the history after the wasp-grub has spun its silken covering. By removing this covering from those most recently spun up, and extracting the contained wasp-larvæ from their cells, the larva of *Rhipiphorus* may be detected still in the interior of some of them. At the side and in front of the third and fourth segments (head being first) of the wasp-larva, the little grub of *Rhipiphorus* shines through the skin, being rendered visible by certain black markings on it—this part of the wasp being nearly transparent, and full of fluid bathing the newly forming limbs of the pupa. On extracting this larva, it bears a general resemblance in size and outline to the youngest larva of *Rhipiphorus* that I had found feeding externally on the wasp-grub, but with the very notable exception of the already-mentioned black marks. These are, in fact, a corneous head, six jointed legs, and a dorsal and ventral series of plates. I immediately recognized the head and legs as identical with those of the little black mite already described, but presenting a ludicrous appearance in being widely separated from each other by the white skin of the larva. I have no doubt that the dorsal and ventral series of black marks are the corresponding plates of the mite-like larva floated away from each other by the expansion of the intervening membrane. By measurement also they agree exactly in size, although the larva extracted from the wasp-grub is ten times the length and six times the width of the little *Meloë*-like larva. In length it is $\frac{1}{6}$ inch (4·5 millim.), and $\frac{1}{28}$ in breadth. Except that its spiracles are not open, its respiratory and digestive systems look just like those of the externally feeding larva. The head (first segment) is black and triangular, with a pair of antennæ situated near its posterior lateral angles: these are three-jointed; the first joint is

short, and supports a bristle beside the long second joint, the last joint being a long pointed seta. In front and above the base of each antenna is a pair (possibly more) of white eye-spots. The mouth and underpart of the head are difficult to make out. There are a pair of strong jaws, each shaped like a comma, with a large globular base and a sharp-pointed extremity. There are two four-jointed palpi, which seem to arise each from the front of a large rectangular piece, which is probably the maxilla. The legs still retain the sucker-disks at their extremities; they have very thick femora and narrow tibiæ*. The dorsal plates are twelve in number (making with the head thirteen segments); the first is of oval outline, flattened in front, and has two short bristles at its posterior angles; the second and third are larger, and have each a small subsidiary triangular piece at the anterior lateral corners; each has a bristle at the posterior angles; the fourth, fifth, sixth, seventh, eighth, ninth, and tenth are narrow, transverse, ribbon-like pieces, the anterior ones straight, the posterior ones curved; and each has a bristle at its outer end, and a secondary piece at each extremity, which also carries a small bristle: the fifth is the longest; and they become gradually shorter to the eleventh, which is a short quadrangular piece with a mere indication of bristles; the twelfth is triangular, with a long seta springing from below each side. The first ventral piece is nearly square, except that it is rounded behind and much hollowed out in front; the second is less so; the third is narrow antero-posteriorly, but of the same breadth; each of these has a strong spine closely adpressed and directed backwards near each anterior angle; the fourth to the tenth are narrow transverse pieces, slightly arched, with the convexity forwards, and each smaller than the previous one, and each with three bristles on either side near its posterior edge; the eleventh is oval, with two rather longer bristles at the sides, and two shorter ones between them; the twelfth is similar to but smaller than the eleventh, and with only short bristles; the thirteenth is immediately behind this and close to the extremity of the body; it consists of a rounded subtriangular piece, with its outer rounded extremities curled round so as nearly to meet, and a separate narrow piece at its posterior margin; from within the curled edges there proceed backwards two transparent processes, each with a disk-shaped extremity.

The dorsal plates are situated in the sulci between the

* A careful examination of a prepared specimen of the suckers shows them to be appendages of a three-jointed tarsus, in addition to which there are one or two claws (spurs at the extremity of the tibia?).

segments, the ventral ones about the middle of each segment. All these plates are of a delicately tessellated structure, as if constructed of flattened cells arranged in arches springing from their posterior margins; the femora have a similar structure, and, in a prepared specimen, I see that their dorsal margin is toothed where the different cells overlap each other.

These plates may be regarded as a beautiful display of the dermal anatomy of the little active larva; and the above description is doubtless equally applicable to it. As a parallel instance I may refer to the case of the female of the white ant, as described by Smeathman, where he mentions the *Pulex penetrans* as the only similar instance known to him. In examining the little active larva I did not notice any setæ, except a short one at the side of each segment; these were probably those of the secondary dorsal plates. I found more than a dozen of these larvæ within full-grown wasp-larvæ, and had the pleasure of watching three of them emerge from the wasp-grub. The usual, and, I believe, the only normal, place to emerge is at the anterior aspect of the fourth segment (head = 1st). The *Rhipiphorus*, which is usually in motion, and for its situation might be called tolerably active, is seen to lay hold of the interior of the skin with its anterior legs, and keeps biting and scratching with its strong and sharp jaws until it is able to thrust through its head, when, in less than a quarter of an hour, it completely emerges by a vermiform movement; and at the same time it casts a skin, together with the black head, legs, plates, &c. Its anterior surface as it emerges is directed towards the head of the wasp, and, bending forwards as it emerges, and guided probably when in its natural position by the wall of the cell, it passes forwards as it emerges along the anterior surface of the wasp-grub, until its head comes somewhere near the second segment of the wasp on its dorsal or lateral aspect, where it at once seizes hold. When removed from the cell, as those I examined were, the first few segments of the *Rhipiphorus* came directly outwards, though they equally succeeded in seizing the wasp-grub by the shoulder. The place of emergence is marked by a slight puckering, and by the black particles of the cast skin. There seems to be no escape of fluid from the wound thus made: for one thing, it is smaller than the diameter of the *Rhipiphorus*-larva, which squeezes through it and plugs it for the time; and afterwards it is to a certain extent stopped by the cast skin of the *Rhipiphorus*.

The position of the *Rhipiphorus*-larva inside that of the wasp, when it is ready to emerge, is with the head to the

point of emergence at the front of the fourth segment, with its body extending into the flanks of the second and third segments, and its ventral surface towards the skin of the wasp. The larvæ that I found in the still feeding wasp-grubs were clearly in the general cavity of the body of the wasp, among its fat-masses &c., and not, as I imagined might be the case when I had only seen them in spun-up grubs, between the larval and pupal skins of the host. I may mention that when the young *Rhipiphorus* has emerged, the black markings of its cast skin are always easily detected in front of the fourth segment. All that I allowed to do so emerged within four hours of the taking of the nest; and, to take a round number, it seems probable that they do so within six hours of the spinning-up of the wasp-grub. This idea is confirmed by the fact that though all the still infested grubs had the dislocation of the larval head that occurs so soon after spinning up, some had no trace of the pupal eyes, and others but a faint brown mark. I have described the *Rhipiphorus*-larva in this stage as being 4½ millims. in length, and I find I have notes of larvæ feeding outside the wasp of less than 3 millims. On emerging, the larva becomes shorter and thicker, and very soon loses length by that curving forwards of its head which is so marked in the full-grown larva, and which does not exist before its emergence. The young larva of *Rhipiphorus* is now found lying like a collar immediately under the head of the wasp-grub, and is attached to it by the head, though not very firmly. At this stage the feeding of the young *Rhipiphorus* is rather sucking than eating. In the case of a larva 4 millims. in length, the wasp-grub was rather flaccid at the upper extremity; one of the pupal eye-marks had disappeared; yet there was no wound of any size in the skin, though very slight pressure caused fluid to exude. When we examine the mouth-apparatus of the *Rhipiphorus*-larva, we see that, though it must make a wound in the skin, its jaws are ill-adapted for any thing like eating. As the *Rhipiphorus*-larva grows, its hinder segments pass downwards in front of the wasp-grub, and its mouth retains hold of the upper extremity of the wasp-grub. When it has grown to a length of about 6 millims., it casts its skin for a second time; and, so far as I have been able to observe, it only does so twice (the first time was on emergence from the wasp-larva). The skin splits down the back, and remains attached to the front of the larva, lying between it and the wasp. When the *Rhipiphorus* has grown as large as the diminished wasp-grub, the latter, partially eaten (for by this time some of its skin has disappeared), easily accommodates itself to the other occupant of the cell;

and about this period the curving forwards of the head of the beetle-larva, hitherto well-marked, becomes extreme. Although there is still a good deal of wasp to be eaten, the cell from above (in natural position, of course, below) shows only the back of the thoracic segments of the *Rhipiphorus*-larva, the remains of the wasp lying in the space formed by the flattened front of the *Rhipiphorus*, from the sixth to the eleventh segments. So far as tolerably close observation enables me to say, it seems that the wasp-grub entirely disappears, any portions held in the mouth of the *Rhipiphorus* merely meaning that the latter has not quite finished its meal; even the head and jaws of the wasp appear to be swallowed. The larva of *Rhipiphorus*, as it becomes full-fed, evacuates an insignificant amount in the form of a few small reddish pellets.

I can see no difference between the silken dome over a normal wasp-grub and that over a *Rhipiphorus*. I mention this not to show that *Rhipiphorus* does not spin it, which is sufficiently clear, but to show that it is not interfered with by the proceedings of *Rhipiphorus*, and that the wasp-larva is able to spin it as usual, although it is attacked before it has begun to spin. Nevertheless, although the silk is the same, as soon as the *Rhipiphorus*-larva has grown at all, the cell is easily detected. It looks decidedly whiter than the surrounding cells, from the larva or immature pupa of *Rhipiphorus* shining through. The larva of *Rhipiphorus* is much whiter than that of the wasp; and the pupa is quite white, whilst that of the wasp has two large brown or black eyes. As the time of emergence approaches, the *Rhipiphorus*-cell looks blackish or reddish as compared with the greenish tint given to the silk by the shining through of the black and yellow face of the wasp.

The holes that Mr. Murray observes so frequently in the silken dome covering the *Rhipiphorus*-cells are not to be found over those that are still small, but over full-grown larvæ and pupæ; they may frequently also be seen over healthy wasp-pupæ. They are evidently made by perfect wasps, who investigate every thing that appears unusual in the cells, with the apparent object of removing a dead larva; at any rate, the presence of a living *Rhipiphorus*-larva seems to satisfy them as well as one of their own pupæ.

The wasp-grubs and pupæ always face towards the centre of the comb, those of *Rhipiphorus*, as follows from its mode of devouring its victim, always face in the opposite direction; they look to the outer angle of the cell, rarely to the one next it on either side. The perfect *Rhipiphori* emerge about two days after the wasps of the same row.

I do not know the time required by *Rhipiphorus* to go through these changes; it is something more than that required by the wasp from spinning-up to emergence; but what this is, I do not know. That this is much less in the nest naturally than in the captive comb is almost certain, as the temperature of the nest is, no doubt, very high. In captivity it is twelve or fourteen days. Even this period is quite compatible with a larva of *Rhipiphorus* of about 5 millims. growing in two days large enough to fill up the top of the cell, as we see it does before it is full-grown; and this was doubtless what Mr. Stone saw, as the *Rhipiphorus*-larva becomes a pupa at about the middle of the period of twelve or fourteen days mentioned above.

In connexion with this very rapid development of *Rhipiphorus*, the following fact is very interesting. Many larvæ, when about to assume the pupa-state, present obvious indications of the eyes of the imago beneath the skin of the second or even of the third segment. This, we have just seen, occurs in *Vespa*; and on this, with some other facts, Ratzeburg founded the remarkable, though untenable, theory that the head of the imago was the first and second segments of the larva combined. In reality, the rapidly developing head leaves its previously too small quarters, and finds room by pressing backwards the other parts beneath the effete skin; and having done so, the various parts of the head, and first of all the eyes, begin to show themselves as development proceeds. In most insects this is a process involving several days; and the distortion caused by the head taking up its new position is very evident long before any trace of eyes is visible; nor is any change observable until after the larva has done feeding. Having examined a full-fed larva of *Rhipiphorus*, I observed, as usual, these eye-spots placed well back in the second segment. But I was much surprised, on examining a larva that was still feeding, to observe the eye-spots within the head of the larva, showing that the eyes of the imago were beginning to develope, both before the larva had done feeding and before the imaginal head had assumed its larger dimensions. These eye-spots consisted of a patch of little brown pigment-points—one for each facet of the perfect eye.

The young external larva is semitransparent, with none of the masses of white fat that obscure the interior of the full-grown larva, and render it white and opaque. Each of the first five segments after the head presents two large dorsal prominences, one on each side; and the tracheal system and intestine can be easily made out. The latter is a large simple

sac, pale yellow in colour, with numerous circular markings and rounded dots, and is in continual rhythmic movement. The tracheal system is very like that of other Coleopterous larvæ; it is probably the same in the full-grown larva, as the positions of the spiracles are the same. From the first to the second spiracle the lateral trunk is double; and about its middle is a short branch, the abortive second thoracic spiracle: the only difference from the Coleopterous type is that there is no spiracle in the twelfth segment; but there is a distinct short tracheal trunk running towards the skin to represent it.

The full-grown larva has a very close superficial resemblance to a *Crabro* or *Pemphredon* larva. It is 11 millims. in length (this is from the fourth to the twelfth segment); from the jaws to the last segment it is dorsally 21 millims., but ventrally 8 millims.; its lateral diameter is $4\frac{1}{2}$ millims., its antero-posterior $2\frac{1}{2}$ millims. It is therefore much flattened; and this flattening is chiefly in front. The head is very small, and curved forwards so as to be almost out of sight, the front of the head being directed rather towards the body of the insect than directly downwards. It possesses a pair of triangular jaws produced at the apex into an extremely sharp point. There is a transverse line beneath these; and there are eminences, that may be called labrum, maxillæ, and labium; but I cannot determine the actual mouth-opening or any other apparatus, except that a to-and-fro sucking-movement is observable among the contents of the head. The second segment is rather large, and possesses dorsally a large trefoil boss on either side; it is in the front part of this that the eye-spots are visible when they have quitted the larval head. These bosses are separated from the head by a narrow smooth surface; a small lateral tubercle intervenes between them and a lateral or ventral process. A similar lateral or ventral process belongs to each of the two following segments; and I may describe them together: each extends laterally, is conical and somewhat pointed, and is divided by constrictions into three portions. As they are also distinctly anterior to the lateral tubercles proper, I think they must be called legs, although they possess no corneous plates or claws, and are in fact of the same pellucid structure as the other tubercles; they appear to assist, passively rather than actively, in holding the wasp-grub. The third and fourth segments have each two large dorsal bosses or tubercles, with two smaller ones beneath each, and an indication of a lateral tubercle. The fifth and sixth segments have similar but less marked dorsal tubercles. All these segments are much narrowed ventrally. The sixth with the following segments form the longitudinal portion of the body of the

larva; they are much compressed from before backwards, this being most marked in front. Though nearly plain at the actual dorsal, ventral, and lateral lines, the segments are very deeply incised in front and sometimes behind, though this is not marked behind in a plump larva: these segments have an indication of dorsal tubercles. The twelfth segment is smaller than the others, and is very narrow in front, as the last segments curve forwards and upwards; the thirteenth, still smaller, appears to be divided into two, and there is, in addition, a very distinct rounded anal tubercle. The dorsal vessel is a straight hiatus between the masses of white fat, and, though it is not so, looks not unlike a groove; and in a larva preserved in spirit the skin might readily shrink into it and actually make it one. Except the tubercles, dorsal vessel, and some of the intervals between the segments, the body is full of white fat disposed in small rounded convoluted masses. The spiracles are eight in number on each side: the first is near the anterior border of the third segment, about halfway between the dorsal and leg tubercles; the second is just above and in front of the lateral tubercle of the fifth segment; the others are in the six following segments, in a little hollow behind the lateral projection, and near the anterior part of the segment. The twelfth segment has a similar hollow, but no spiracle. In the third and fourth segments there are seen very early a pair of tracheæ on the side of each, which indicate the wings and elytra already forming.

The point which most requires investigation is the place and manner of oviposition of *Rhipiphorus*. As the young larva is active, it is by no means necessary that the eggs be laid in the nest of the wasp; and I have never found a *Rhipiphorus* in any of the numerous wasps' nests I have examined, except such as had recently emerged from the cells. I have found the larvæ also very abundant in some nests, in others very scarce, only two or three sometimes in the whole nest. Were the eggs laid in the nest, they should always be either abundant or absent. I do not know it from my own observation; but I believe that the perfect beetles hibernate—wherefore the eggs must be laid in spring and summer. I have in vain, however, caught and examined many wasps at large, in the hope of finding them infested by young *Rhipiphorus*-larvæ, as the *Andrenæ* &c. are by those of *Meloë*. In determining the oviposition, the young larvæ would incidentally be obtained in large numbers. All other methods I have tried to obtain more than the one I accidentally met with have failed. I intend to secure as many perfect *Rhipiphori* as I can, and to

try to keep them over the winter, in order, if possible, to obtain the eggs.

EXPLANATION OF PLATE XVI.

Fig. A. Larva of *Rhipiphorus paradoxus*, from the interior of a feeding wasp-grub, magnified 32 diameters: the small figures 1, 2, 3, &c. mark the head and dorsal plates, the latter being placed at the anterior margins of their several segments.

Fig. B. Dorsal view of larva of *Rhipiphorus paradoxus* when about to emerge from the interior of the spun-up wasp-grub, magnified 12 diameters.

Fig. C. Ventral aspect of the same larva. The figures refer to the segments as in figure A, the ventral plates being placed about the middle of each segment.

Fig. D. Dorsal view of head and dorsal plates of larva of *Rhipiphorus* (figs. B & C); the numbers refer to the corresponding segments of the larva; magnified 100 diameters.

Fig. E. Ventral view of head and ventral plates of the same larva, similarly numbered, magnified 100 diameters. The legs of one side are represented, numbered with their corresponding segments.

Fig. F. Leg, magnified 200 diameters.

Fig. G. Mandible of right side, magnified 300 diameters.

Fig. H. Dorsal plate of fourth segment, magnified 210 diameters, showing tessellated structure. Figs. D, E, F, G, & H are drawn from specimens mounted in turpentine.

Figs. I & K. Lateral and ventral views of the tracheal system of the recently emerged larva, magnified 14 diameters, showing the position of the spiracles and indications of the positions of the obsolete spiracles of the fourth and twelfth segments: *a* shows the appearance of a portion of the intestinal tube of the larva at this stage.

Fig. L. Full-grown larva of *Rhipiphorus paradoxus*, lateral view.

XXX.—*Note on the Egg of* Rhipiphorus paradoxus. By Andrew Murray, F.L.S.

Dr. Chapman having been good enough to communicate to me, before publication, his admirable discovery of the early stage of *Rhipiphorus paradoxus*, I crave a few lines to congratulate him upon his success and to express the gratification which I and, I am sure, all other entomologists feel at the clearing-up of the puzzling and mysterious life-history of this insect.

So soon as Dr. Chapman pointed out to me the key of the mystery, I had no difficulty in procuring a number of specimens of the larva of *Rhipiphorus* in its first or internal stage of parasitism. I have not been fortunate enough to see it actually come out and change its skin, and then fix its embrace upon its victim; but Dr. Chapman has himself seen this,

T. A. Chapman & T. West del. Tuffen West sc.

and some points of resemblance in the appearance (dissimilar in other respects as they are) of the parasite in its internal and external stages doubtless prepared him for the discovery that it did so.

In his last communication to me on the subject, he mentioned that the only point in the history of the creature which he had not seen, and which still required to be made out, was the egg and the mode of laying it. He has perhaps by this time cleared up this part of the mystery too, in which case the following observations made by my correspondent may at least be worth a place as confirmation. If he has not, then it carries on the history a trifle further.

Of course Dr. Chapman's discovery shows that the supposed egg, which I figured with doubt in my last paper, was not really the egg, but the young parasite newly emerged. Since then I have seen (by means of post-mortem examination) the real egg in quantity inside a female *Rhipiphorus*, and also an egg laid by the parent. It is a great deal smaller than the supposed egg, and also a great deal smaller than the wasp-egg, scarcely a fourth part of the size of the latter.

Among the *Rhipiphori* saved from the last piece of comb that came into our possession were two most healthy females and a miserable male, which was picked out of a cell before he could walk, and which went scuffling about on his back or any how for some days, until on Saturday, Aug. 27, he became very brisk. That evening one of the females was observed with her ovipositor stretched out to a most extraordinary length and applied to the side of the little chip box in which they were kept. It remained so for a brief time, and when she withdrew the ovipositor, she left something beside the egg like gummy thread collecting into a drop. On taking up the creature, she was easily compelled to put her ovipositor in and out, so that it could be examined in its natural state. It is very slender, tapering, and apparently ringed (perhaps the rings are signs of a telescope arrangement), and furnished with bristle-like appendages directed towards its point; and, although very flexible, it has firmness enough to visibly press in the skin of a wasp-grub to which she was made to apply it; but no puncture could be detected.

This does not tell us very much. Her laying an egg on the wall of the box is against the notion that she may deposit her egg inside the wasp-larva by piercing its skin, like an ichneumon; so is the gummy secretion; while, on the other hand, it has been suggested to me that the ovipositor with its bristles may be something analogous to the serrated

ovipositors of some of the sawflies. I incline to the view that it simply deposits the egg in the cell or on the body of the wasp-larva. So far as I know, there are no Coleoptera that have penetrating ovipositors, or that deposit their eggs as internal parasites, as ichneumons do; and I do not see what use a barbed weapon would be in cutting into the inside of a wasp-grub; a gimlet or simple point for cutting through the skin would of course be necessary for penetration; but after the skin was once penetrated, the rest would be still easier to the same implement.

The experiment was tried of inoculating a wasp-grub or two by puncturing the body and inserting in each an egg taken from the body of a female *Rhipiphorus* that died. These all came to nothing, which, however, might be due as well to the eggs not being fertilized or to their being taken from a dead mother as to their being put in an unnatural nidus. On another opportunity I shall try the experiment of laying the egg on the body of the wasp-grub, and see what comes of it.

Another thing, however, we gather from these observations; and that is, that the *Rhipiphorus*-eggs are formed and laid a few days after the perfect insect comes out; and from this we may further argue that, under ordinary circumstances, at all events in the second brood, the female *Rhipiphorus* lays her eggs before leaving the wasps' nest, and does not enter it in advanced life for the purpose. This would account for the *Rhipiphori* not being seen abroad. They are mentioned as found on flowers; but I never saw them there, and never saw any body who had seen them anywhere except in connexion with a wasps' nest. Their whole life, birth, internal parasitism, external parasitism, pupadom, maturity, marriage, propagation, and death (if death, as is the case with many other insects, soon follows on the fulfilment of the functions of propagation) would appear to be passed within the narrow limits of a wasps' nest. But if this be so, of what use are their wings and vigorous and rapid powers of motion (which are often disappointing enough)? And how about the first appearance of the founder of the colony in the wasps' nest in spring? I merely notice these things to show that, although Dr. Chapman has taken off the cream of the interest regarding the life of the *Rhipiphorus* by his discovery, sufficient yet remains to render the study of its habits an interesting subject of research.

XXXI.—*On the Ultimate Structure of Marine Sponges.* By H. J. Carter, F.R.S. &c.

The "ultimate structure" of the marine is, *mutatis mutandis*, the same as the "ultimate structure" of the freshwater Sponges.

In July 1857 I described and illustrated the "Ultimate Structure of *Spongilla*," (Annals, vol. xx. p. 21, pl. 1). In January 1859 I expressed doubt as to the position of the cilia in the "ampullaceous sac," and my conviction that they were external instead of internal, contrary to my first statement (*ib.* vol. iii. p. 12). In October 1861 I again returned to my original view, viz. that the cilia were inside (*ib.* vol. viii. p. 290).

This discrepancy I can now adjust; for, the cilium of the sponge-cell being retractile and the sponge-cell itself amœboid and free to change its position *in situ*, the cilia may at one time be put forth outside, and at another inside the ampullaceous sac, the latter probably being their normal position.

Now what is this "ampullaceous sac"? for although it is twelve years since my description of it was published (viz. 1857), no one, to my knowledge, has referred to it but Professor H. James-Clark, of Boston, in June 1866 (Mem. Boston Soc. Nat. Hist. vol. i. pt. 3, p. 1, 1867), a fact which may be excusable to those who have been brought up in a language different from that in which it was published.

"Ampullaceous sac" is the term which I applied to certain groups of unciliated and monociliated sponge-cells or monad-like bodies which are tessellated together in a globular form, and scattered plentifully here and there throughout the sponge so as to make up the greater part of its bulk. The globular form presents a circular opening or transparent area through which the cilia may be observed to play internally; and when the young *Spongilla* is grown from the seed-like body, and a solution of carmine is put into the water around it, these globular bodies *alone* become coloured; that is to say, they alone take in the carmine; and thus their globular form becomes clearly defined and differentiated from the rest of the mass.

Hence the little globular bodies are clearly the animal expression of the sponge in particular, as they are respectively the only mouths and stomachs of the sponge—in short, the nutritive apparatus, all the rest being subsidiary.

When the *Spongilla* thus fed with carmine is torn to pieces, the monad-like bodies (which we shall henceforth call "sponge-cells") of which the ampullaceous sac is composed are found to have taken in the carmine, while the absence of the cilium

in some, and not in others, may be explained, as just stated, by its being retractile.

Further, it was observed that after a time those portions of the carmine which were unappropriated to nourishment were rejected, and, as they fell into the adjoining canal of the excretory system, were thus voided. But whether they passed into the excretory canal through the circular opening or transparent area in the ampullaceous sac, or through another opening in it unseen, or directly through the substance of the body of the sponge-cell, *Amœba*-like, into the excretory canal, I could not determine.

The particles of carmine could be seen to pass in through the holes of the veil or sarcodal investing layer of the *Spongilla*, and thence into the bodies of the sponge-cells; but whether through the circular opening of the ampullaceous sac mentioned or by impinging upon the sponge-cells direct on the external side of the ampullaceous sac, or both alternately, according to circumstances, I also could not determine. All that I can assert is that the particles of carmine did pass into the sponge-cells, and that the undigested parts passed into the neighbouring excretory canal, about the branches of which the ampullaceous sacs are hung like grapes on a grape-stem, and so ultimately out at the single vent (for there is but one at this period), as represented in the illustrations to which I have alluded. I could follow them to the sponge-cell and see them immediately after they fell into the excretory canal; but their intermediate course I failed to observe.

So far, then, it was evident that the ampullaceous sac is the expression of the alimentary apparatus.

To conceive that the nourishing portions of the food, after having been resolved into chime in these sponge-cells, subsequently passed, by endosmosis, into the general mass to become assimilated, is only to assume a fact common to all living structures, a fact which is as certain by assumption as the ejection of excrement is open to ocular demonstration.

Thus the normal course in *Spongilla* is for the particles of food to be received through one channel and its undigested portions to be ejected by another. Where the opposite takes place, it is an exception to the rule, or abnormal.

When the young *Spongilla* became replete with carmine, it closed the pores of the investing membrane and the single osculum of the excurrent system of canals; but after a certain time all were again opened, and then the carmine, which during the interval still remained in the sponge-cells (*not in the excretory canals*), began to be separated from its nutritive portion and its particles to fall from the sponge-cells into the excretory canals and so be voided.

Perversions of the currents do take place occasionally under certain circumstances. Thus Dr. Bowerbank, in his "Report on the Vital Powers of the Spongiadæ," published in the Report of the British Association for the Advancement of Science for 1856, alludes to an occurrence of this kind, on which he observes:—"(June 9.) The reversal of the action in the osculum in this instance was apparently effected by the vigour of the action in the *other* group of oscula, the whole of these organs being more or less connected." The italics are mine.

On the other hand, Häckel ("On the Organization of Sponges and their Relationship to the Corals," translated in the Annals, vol. v. p. 1, January 1870) observes at p. 9:—"I (with Miklucho) designate the largest cavity into which the canal-system is dilated in the sponge-body, and which is usually called the excurrent tube or flue (*caminus*), as the stomach, or digestive cavity, and its outer orifice, which is usually called the excurrent orifice or osculum, as the buccal orifice or mouth."

Marine Sponges.

The chief part of what I have described in *Spongilla* I have been able to identify in the "ultimate structure" of the marine sponges, both calcareous and siliceous,—that is to say, the presence and persistence of the ampullaceous sac, which may always be recognized, entire or fragmentary, as the case may be, in a more or less globular group of spherical monociliated sponge-cells in the living state—and in the dried or wet preserved state (here of course without the cilium), innumerably scattered throughout the mass, and thus presenting the points at which the nourishing-apparatus is situated, just as certainly as if this had been proved by the testing process of carmine practised in *Spongilla*.

Were it as easy to keep the marine sponges alive as the freshwater sponges, no doubt their growth in a watch-glass, feeding with carmine &c., and the consequent phenomena might also be as easily observed; but the recognition of the existence of the ampullaceous sac, as all the rest has been witnessed in *Spongilla*, is sufficient. The only wonder to me is that what I have stated of *Spongilla* has not been identified by others; it is so easy to grow this sponge in watch-glasses from the seed-like bodies.

Siliceous Sponges.

I first noticed more particularly the ampullaceous sac in the marine sponges in December last, viz. in *Halichondria simu-*

lans, Johnston (*Isodictya simulans*, Bowerbank), which, with the exception of *Halichondria panicea*, Johnston, is the commonest sponge in this locality (Budleigh-Salterton, Devon). It has been figured by Schmidt in *Reniera*=*Isodictya*, viz. in *R. aquæductus*, Sdt., and *R. semitubulosa*, Sdt., in the Histiological Supplement to his ' Sponges of the Adriatic Sea' (Taf. 1. figs. 17 and 18 respectively, 1864), under the name of "Wimperkorb."

The smaller the specimen is, provided it be entire, the better, because it lives longer than the large portions, which require so much more water and the water to be so often changed that, although this be done daily, they soon die and get putrid. Besides, a small portion can be kept in a watch-glass and thus easily brought under a high power of the microscope for observation, which with a large portion is almost an impossibility.

That which I selected was about a quarter of an inch in diameter; and when torn to pieces for microscopical examination (which must always be conducted in fresh sea-water to keep the cilia moving and alive), the ampullaceous sacs were observed to be about 1-750th of an inch in diameter, and the sponge-cells of which they were composed about 1-8000th of an inch in diameter. The ampullaceous sac was also seen *in situ* among the meshes of the spicular structure, and there also to be of the same size.

On a subsequent occasion I found a *pink* portion of the same sponge, which appeared to have obtained its colour from growing in contact with a species of *Rhodymenia*; and on tearing this to pieces I observed that the pink colour was confined to the ampullaceous sacs—that is, to the sponge-cells composing them. Hence I inferred that the sponge had been feeding on the fronds of the *Rhodymenia*, which sponges will do, just as fungi enclose and feed upon leaves and wood.

As regards the colouring-matter of sponges generally, I think it will be found to be chiefly confined to the granular contents of the sponge-cells composing the ampullaceous sac.

Thus, in *Spongilla*, when any part of this sponge presents a green colour, it appears to be confined to the granules of the sponge-cells of this sac,—that is, if the colour be in the sponge itself and not owing to the presence of a foreign agent. In the scarlet sponges, to wit, *Microciona atrosanguinea*, Bowerbank (*Scopalina*, Schdt.), it is confined to the ampullaceous sac and the still more scarlet gemmule which I have reason to think is but a transformation of this sac. Lastly, in a soot-black sponge (*Dercitus* (G.) *niger*, mihi) belonging to the Tethyad family of Dr. J. E. Gray ("Notes on the Arrangement of Sponges," Proc. Zool. Soc. Lond. May 9, 1867, p. 542), which

appears to me to be undescribed, and which I have just found on the rocks here, the black colour is owing to the ampullaceous sacs, which, although scattered throughout every part of the sponge, are brought together in much more close approximation on the surface, where they form a layer 1-12th of an inch thick, of intense blackness; and when a portion of this layer is torn to pieces, the black colour is found to arise from the presence of one or more black granules in each of the sponge-cells, which thus collectively give the black colour to the ampullaceous sac, and the latter, in great numbers and close approximation, to the uniform and characteristic blackness of the surface of the sponge.

(This layer, which is supported on another internally, formed of stout quadriradiate spicules, and covered externally by a thin transparent dermal layer charged with short bacillary spinous ones, the spicules of the body being 4-radiate and *tricurvate*, I propose to notice more in detail in a future communication, describing and illustrating the whole sponge.)

But to return to the ampullaceous sac in the living marine sponges, I have, besides observing it in *Halichondria simulans*, seen it in all the rest that I have examined where I have looked for it particularly. I have dried pieces of the Geodidæ, too, in which it is obvious; but in the dried sponges the ampullaceous sac or little globular group of sponge-cells which represents it will not be preserved if the specimens have not been dried while fresh and living. Putridity destroys them; and therefore all weathered specimens, such as are chiefly found on beaches, will probably fail to exhibit them.

Calcareous Sponges.

In the calcareous sponges, on the other hand, the tessellated arrangement of the sponge-cells in distinct compartments has been well described by Dr. Bowerbank since 1848 (Trans. Microscop. Soc. vol. iii. p. 137); and it only remains for me to add that, by making sections of dried specimens of *Grantia ciliata* in all directions, these compartments are found to open into each other, finally terminating by a round aperture in the general cavity or cloaca of the sponge.

I have also lately observed, in tearing to pieces portions of living *Grantia nivea*, which is a massive sessile form with branched system of excretory canals and oscular vents, and also portions of a beautiful *Clathrina* (Gray) which extends its white lace-like network over the under surfaces of rocks here in great abundance, with many other species of calcareous sponges, that the same kind of ampullaceous sac with its cilia waving internally exists in all, as in the siliceous *Isodictya*

above mentioned, but with this difference, viz. that the sponge-cells are double the size of those in *Isodictya* and the siliceous sponges—that is, about 1-3000th of an inch in diameter.

Thus it is proved that the ampullaceous sac is the eating-organ in *Spongilla* and in the marine sponges, both calcareous and siliceous, generally.

I have alluded to the "investing membrane," or veil of sarcode which covers the young *Spongilla* (Annals, *l. c.*), in which I have also shown that holes are extemporized for allowing the particles of food to enter into the interior and be there taken up by the sponge-cells of the ampullaceous sac; and it is this veil which in all sponges alike (that I have examined) creates a cribriform layer over the inhalant areæ as it is required, but *never* over the exhalant areæ or oscula.

For a more complete account of the nature of this veil and its apertures I must refer the reader to my paper "On the Ultimate Structure of Spongilla" (*l. c.*), and for illustrations of it in the Geodidæ (*Sphærospongia*, Gray) to my illustrations of *Pachymatisma Johnstonia* (Annals, vol. iv. p. 8, pl. 2. figs. 10–12, July 1869). Further in, in the pore, in the latter there is an expansion of the sarcode which has been called by Dr. Bowerbank the "diaphragm;" but it is generally, if not always, a more or less spiral plane of the sarcode (fig. 12, *l. c.*) in conjunction with the spiral arrangement of the minute holes respectively in the cribriform layer of sarcode overlying it externally, each of which is also more or less spiriform, as may be seen by placing a perfect portion of the crust under the microscope with its inner side uppermost, and viewing it by transmitted light through the pores.

This spiral arrangement of the holes in the dermal sarcode overlying the pore as well as that of the diaphragm in the pore itself, I have just now satisfactorily seen in a piece of *Pachymatisma Johnstonia* that I found growing on the rocks here; also I observe that the "diaphragm" is just as much developed in the large oscula as in the pores, so that it is not peculiar to the latter.

Owing to the short shafts of the triradiate spicules which support the crust of globular crystalloids in *Pachymatisma Johnstonia*, portions of the latter come off entire when the sponge is roughly raised from the rock on which it may be growing; and thus the organs and structure of the surface may be easily seen, especially after exsiccation—differing thus from *Geodia*, where the shafts of the triradiate spicules are so long and so numerous and the whole zone so much more developed in this respect, that the crust and the zone of triradiate spicules generally come away together, and cannot be separated without much injury to the former.

On comparing the Sponges with the Polypes or Corals, one cannot help being struck with the want of a second channel for the evacuation of excrementitious or undigested portions in the latter, while its presence in the former allies the sponge more to the Polyzoa and Tunicata. Then the total absence of thread-cells in the latter and their invariable presence in the former still further allies the Sponges to the Tunicata, while it equally separates the Sponges from the Corals. It is true that the organs of the Tunicata are much more developed or differentiated than those of the Sponges; so are the ovaries &c. of the Corals. But this does not militate against the Sponges being at the end of the branch of palæogenetic development leading to the Polyzoa and Tunicata rather than to that leading to the Corals.

Again, the little heads of inhalant areæ in *Osculina polystomella*, Scht. (Spong. Algier.), in *Grayella cyathophora*, Cart. (Annals, vol. iv. September 1869, pl. 7), and probably more or less in all the Clionidæ, have a structure very much like the tentacular orifices of Polypes—indeed so much so that in *Cliona coralloides*, Hancock (Annals, vol. xx. April 1867, p. 229, pl. 7. fig. 3), which I have just had under observation in salt water, I thought I had a colony of little Polypes under the microscope. They were scattered (upwards of one hundred of them, each about 1-48th of an inch in diameter) over the outer side of a deciduous *Balanus*-shell, which was about an inch wide at the base and about half an inch high; and when first I observed them, each presented the appearance of the convex iron grating used for sinks. Some were round, but most oval; and all possessed this grating-like opening, except the vents, which were known by their single circular aperture. On examining the little heads, however, more particularly, it was observed that each consisted of a variable number of prolongations of the sponge-structure (often more than a dozen), which, tentacula-like, rose upwards all round to form the dome-like prominence of the head during projection—that, also tentacula-like, they ended in tongue-like terminations, but that these terminations were tied together by the investing layer of transparent dermal sarcode, which thus transformed the whole head into a convex cribriform structure into which the floating particles of the vicinity were observed to be drawn, as, on the contrary, they were observed to issue from the pores or vents with *single* circular aperture.

(On removing the calcareous shell of the *Balanus* by acid and drying the remainder, these little heads, which presented a white colour, were found to be wide at their base where they joined the sponge, then constricted so as to form a neck, and

then expanded into the head, while the white crust was formed of the peculiar bacillary, sinuous, spined, minute spicule which Hancock gives (*l. c.*) as the characteristic one of the species, pierced by the points of a bush of pin-like spicules, which, as I have before stated, in the Clionidæ appear to be almost exclusively confined to these heads, the incipiently but densely spinous acerate spicules of this species being, as in *Grayella*, almost as exclusively confined to the body of the sponge.

Thus in the extension upwards of the ribs, composed of sarcode charged with spicules and based on the general structure of the sponge of which they thus formed tongue-like prolongations, I thought I saw the tentacles of a polype; but the clathrous netting together of their tips and sides with the investing sarcode, and the rush of particles in through the lattice-work thus produced, showed me that, however much these little retractile heads were like in form, they were not so in function to the tentacular mouth of a polype. In short, they did not act as the fringe of tentacles in *Actinia* and the Polypes, which are prehensile organs. They acted as sieves to strain the water and prevent the entrance of particles which might be too large for the sponge-cells to enclose, or otherwise inconvenient for the sponge to receive. Thus in form they partly represented Polypes, but in function sponge-structure.

In Häckel's valuable paper (Annals, *l. c.* p. 4) Leuckart is quoted as having stated that, "if we imagine a polype-colony with imperfectly separated individuals without tentacles, stomachal sac, and internal septa, we have in fact the image of a sponge with its large 'water-canals' opening outwardly." That is to say, in short, "we have only to pick out the polypes of a polype-colony to have a sponge."

After this, at p. 10 (*op. cit. l. c.*), Häckel alludes to certain "fine apertures in the skin [of corals] usually perceptible only through the microscope," which he considers deserving of the term "incurrent apertures" designed for respiratory purposes just as much as the pores of the sponge; but he previously admits that "the part played in the process by the cutaneous pores of the corals is unfortunately still as good as unknown."

With equal reason it seems to me we might liken the canaliferous structure which pervades the cartilaginous cœnosarc of the compound Tunicata, if not that of the tests of the Polyzoa and Ascidians also, to the canaliferous structure of the Sponges. Nor are many of the compound Tunicata wanting in the spicular element—which, under definite forms, abounds in some species to such an extent as to give them the white appearance of calcareous sponges, for which, at first sight, they

may be easily mistaken. Up to this time, however, I have only found this spicular element to exist in the shape of two forms of globular crystalloids of carbonate of lime covered with points similar to some of the siliceous spherical stellate bodies of *Geodia arabica* (Annals, vol. iv. July 1869, pl. 1. fig. 13 *a*)—not of the globular crystalloids of the crust, which all have a depression in one part of their surface. Such a depression does not appear to exist in the radiated globular crystalloids (spicules) of the compound Tunicata.

Hence it seems to me that the Sponges are just as much a step to the Polyzoa and Tunicata as to the Corals, if not more so.

But when we turn to the Foraminifera, the case is quite different; for here indubitably (as in *Difflugia*, which belongs to this class) the food is taken in and the undigested portions ejected through the same aperture. And if we advert to *Squamulina scopula*, which I described and illustrated in the Annals (vol. v. p. 309, May 1870), we shall there see that the *Difflugia*-like head arises from hypertrophy of the central cell of a nautiloid form of Foraminifera, while the ovary is divided among the atrophied septa and chambers of the nautiloid test at the base or "pedestal," which thus at once gives us an early condition of an *Actinia* or polype, the pseudopodia being the early condition or true homologues of the tentacles of the latter, if not the "atrophied septa" those of the septa also.

Still where, it may be asked, is the canaliferous structure? Observation seems to point out that there are tubular communications directly through the tests of *Difflugiæ* and the Foraminifera whose functions have not yet been defined. Like the minute apertures on the skin of Corals, they may perhaps be for respiratory purposes, and, if connected with the stomachal cavity, would be the homologues of the cœlenteric vascular system in the Corals. But, as Häckel states of the cutaneous pores of Corals, the part they play "is unfortunately still as good as unknown."

One does not assume that the inhalant pores of Sponges may not be in part respiratory organs, but that, unlike the Corals, they serve the purpose also of sifting the nutritive material which is drawn in through them by the internal organs of the sponge—in short, that, as in the Tunicata and Polyzoa, the respiratory water and the food enter the body through one aperture and come out at another.

I have stated that there is only one vent in the young *Spongilla* grown from the seed-like body; but sometimes (see my "Ultimate Structure of *Spongilla*," *op. cit. l. c.* p. 31) "it happens that one of the large branches of the efferent system bursts and gives rise to an efferent current before the tubular

vent resumes its original dimensions and opens its aperture, by which two efferent currents are subsequently established, for the abnormal one does not close when the normal one becomes opened."

Dr. Bowerbank also (Brit. Assoc. Advanc. Science, Report for 1856) notices ("June 10") the opening of several new oscula and the closing of old ones in the piece of *Hymeniacidon caruncula* which he was watching, as if they could be closed and extemporized like the holes of the investing sarcodal layer when and wherever required. On *Pachymatisma Johnstonia*, too, and many other sponges, the great vents are congregated into groups in one or two places, and not distributed generally, as if the sponge were divided into districts each having its respective vent. Yet Häckel states (p. 8, *l. c.*) that his investigations have confirmed him "in the opinion quite recently put forth by O. Schmidt, that every part of the sponge-body which possesses an excurrent orifice (*osculum*) is to be regarded as a distinct 'individual.' This 'true individual' of the sponge-body I [Häckel] denominate, in accordance with my theory of individuality, a 'person;' and every sponge-body that consists of two persons (*i. e.* that possesses two or more oscula) I denominate a 'stock' or 'cormus.'" Häckel's theory may suffice for the Calcispongiæ, but I doubt if it will apply so generally to the Siliceous Sponges.

Generative Organs.

What these are in the Corals or Polypes and Tunicata is evident. But where are they, and what are they, in the Sponges?

The seed-like bodies of *Spongilla* I have long since compared with the winter-egg of the freshwater Polyzoa (Annals, vol. iii. p. 331, May 1859, pl. 8); and the ciliated gemmules appear to me to be only another form of them, while all appear to me originally to be but transformations of the ampullaceous sac.

But what is the ovum and what the spermatozoon of the sponge?

In November 1854 (Annals, vol. xiv. p. 334) I published (the reader will be tired of my referring to my publications; if not, I am) a short account, with illustrations, of certain monociliated sponge-cells, which at the time I conjectured to be the zoosperms or spermatozoa of the sponge. In 1858 (Annals, vol. iii. p. 14, pl. 1, January 1859), on account of the conjecture, I put this to the test by feeding a suitable piece of *Spongilla* with indigo, in order that I might see if these monociliated sponge-cells enclosed any, in which case they might be considered not to be spermatozoa, for spermatozoa do not take

in nutriment, at all events not in the form of crude material. They did enclose portions of indigo, as my illustration (fig. 12, *l. c.*) shows; and having made the announcement, I from that time forward hoped that I should never hear any thing more of my original conjecture. Nevertheless it is every now and then brought up as if I had only published it yesterday, and had never added the contradiction which followed about five years afterwards, viz. in 1859.

Thus Häckel, in 1869, states on the subject (p. 110, *l. c.*) :—"What Carter describes as the zoospermia of *Spongilla* are, as Lieberkühn perceived, Infusoria; and what Huxley figures as zoospermia of *Tethya* are very probably vibratile cells. No less doubtful are the filaments which Kölliker describes as the zoospermia in *Esperia*." . . . . "O. Schmidt and Bowerbank, who have examined microscopically many thousands of sponges, have, like myself, sought in vain for male organs of any kind whatever."

Now, as regards my so-called zoosperms in *Spongilla* not being so, my experiment above related, performed and published eleven years since, satisfactorily settles this point. As regards their being Infusoria, every one who knows any thing of living sponge-structure knows that such monociliated cells not only abound in, but absolutely form almost the greater part of it. And as regards Lieberkühn's view, expressed elsewhere, that they were specimens of Ehrenberg's *Trachelius trichophorus* (Dujardin's *Astasia limpida*, see my observations on this point, 'Annals,' vol. iii. Jan. 1859, p. 16), I am rather surprised that Lieberkühn should have come to this conclusion, seeing that *Trachelius trichophorus*, like *Euglena*, progresses by means of its cilium in *front*, and the monociliated cells which I figured and conjectured to be the zoosperms of *Spongilla* progress by means of the cilium *behind*. Kölliker's description of the filaments which he observed in *Esperia* I have not seen. But Huxley's, in a species of *Tethya* described and figured in the 'Annals' (1851, vol. vii. p. 373), so well as I can remember, closely resemble in form what I have just observed in *Microciona atrosanguinea*, which is a very common sponge in this locality.

This monociliated body, which may now be seen, in great plurality, with every portion of the *Microciona* torn to pieces for microscopical observation, consists of a rounded triangular head and long cilium. The head is pyriform or shaped like a Florence flask with the neck drawn out to a sharp point or beak, and the cilium attached to the large end, close to which there appears to be a single granule or nucleus; but in other respects the head is transparent. At first these bodies are in

contact with the glass cover, but soon sink to the plane of the slide, about which they move with the head foremost, apparently urged on in a zigzag course by the undulations of the cilium behind. For the most part they are single, but occasional groups of four are seen rolling over the field after the manner of monociliated cells or spermatozoa which want to become separated from each other. When measured, the head, including the beak, was found to be 1-3000th of an inch long by about 1-12000th broad at the large end, and the cilium seven times as long as the body, or about 1-400th inch long. Under the action of iodine, the head became amber-coloured. While portions of *Microciona atrosanguinea* taken from different localities abounded with this body, together with a number of scarlet gemmules, in addition to the ampullaceous sacs and monociliated cells of the rest of the sponge, portions of other sponges, even on the same piece of rock (for it is most desirable, in examining the living sponges, to bring away with, and not detach from them, the piece of rock on which they grow), failed to present a similar body when torn to pieces under the microscope. Could this monociliated body with triangular head have been the spermatozoon of *Microciona*?

Häckel observes also, at p. 110 (*l. c.*) :—" I regard it, therefore, as most prudent and advisable for the present, to doubt the sexuality of the Sponges," previously having stated, at p. 6, that " in the Sponges, just as in the Corals, and, indeed, in the Cœlenterata generally, all the different parts of the body originate by differentiation from two primitive simple formative membranes or germ-lamellæ, the endoderm and the ectoderm, ... produced by the segmentation of the ovum." And then, at p. 12, with reference to the development of the earliest young form of the Calcareous Sponges :—" After the egg has been broken up, in consequence of the process of segmentation, into a spherical, mulberry-like aggregation of closely adpressed, homogeneous, naked spherical cells, the mulberry-like embryo, by stronger growth in one direction, acquires an ellipsoidal or oval form, and covers itself with cilia. A small central cavity (stomach) is then produced in its interior; this extends, and, breaking through at one pole of the longitudinal axis, acquires an aperture, the mouth."

This is very like the development of the young *Spongilla* from the seed-like body. (See my illustrations of the ultimate structure of *Spongilla*, *l. c.*)

But, if there be an " egg," there must be a spermatozoon. Yet Häckel, as above stated, ends by doubting the " sexuality of Sponges."

Still further, in reference to this subject, I might add that I have twice found a living specimen of *Halichondria panicea* here, of a lilac colour, which, on being torn to pieces, was found to be densely charged with minute spherical capsules, 1-3000th of an inch in diameter, so like the sporidia of the Myxogastres that, as I have before stated in the 'Annals' (vol. v. p. 320, May 1870), but for the presence of the spicules and the specimens being fresh and living, I should have concluded that these cells came from one of the Myxogastres, and did not originally belong to the sponge. Could these have been the true sexual ova of the sponge? By development they would, of course, lose their homogeneous appearance, and become granuliferous.

Having endeavoured to show the near relationship which exists between the Sponges and the compound Tunicata, and the still nearer one which exists between the Foraminifera and Corals, I have only now to add a word or two in conclusion, on the real nature of the animal of the Sponges abstractedly.

The only naturalist, to my knowledge, who has turned his attention directly to this all-important point connected with them is Prof. H. James-Clark, of Boston, to whose valuable memoir on the subject (republished in the 'Annals,' vol. i. p. 133, Feb. 1868) I have alluded at the commencement of this paper.

The object of Prof. James-Clark is to prove that the monociliated sponge-cell is a distinct flagellated infusorium, possessing an oral and an anal orifice respectively, in close approximation, at the bottom of a funnel-shaped retractile expansion which surrounds the base of the cilium, and also a nucleus and two contracting vesicles; further, that this flagellated infusorium is in no sense whatever related to the Rhizopoda; and that it is an aggregation or colony of such Infusoria which produces the "true ciliated *Spongiæ*."

I cannot altogether endorse Prof. James-Clark's views, as I have stated (Annals, vol. iv. p. 196, Sept. 1869); nor do I desire to dispute his conclusions here, my object in this communication being to point out facts which seem to me worthy of consideration, and to leave all hypothetical arguments in support of particular opinions to those who think them of more consequence than I do, merely observing that the amœboid pseudopodia of the Foraminifera (*Difflugia*) and the cilium of the Flagellated Infusoria (*Trachelius trichophorus*, Ehr., *Astasia limpida*, Duj.) appear to be combined in the Sponges, and that, while the former may lead on to the Polypes, the latter may be the initiative form of the Polyzoa and Tunicata.

XXXII.—*On the Use of the Term "Homology."* By E. Ray Lankester.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,

Whilst acknowledging with pleasure Mr. St. George Mivart's recent paper "On the Use of the Term 'Homology,'" I think that I cannot have been sufficiently clear as to the use of the term homogeny in my own article, since he speaks of "ancestral" and "developmental" homogeny. I proposed to signify by "homogeny" simply what he terms "ancestral homogeny." Structures which he would call "developmental homogens," if they are not also ancestral homogens, do not come under my term homogen at all, but are homoplasts. The fact of the absence of ancestral relation at once removes them from the category of homogens. The individual cranial bones of man are not all homogenous, each for each, with those of the osseous fish: but they are homoplastic; *i. e.* conditions other than direct heredity have determined a close agreement of arrangement.

The similarity of the development of so-called homologous parts in two individuals, if it is not considered to be due to homogeny (that is, ancestral community) renders the homoplasy the more remarkable, but does not require the term "developmental homogeny," which, indeed, seems to be an impossible one by the definition of homogeny.

As Mr. Mivart remarks with regard to the imaginal disks of Diptera, it is by no means a constant rule that we find the ancestral epitomized in the individual development of an organism. It is certainly never completely epitomized; and the cases in which it is so to any extent are rare, and of proportionate interest. Here and there in the individual development of organisms we find traces of the epitomized ancestral development; but a large number of the appearances presented in individual development are referable to the immediate relations of the organism to its conditions of existence; and in this way whole pages of history are blotted out or reduced to an indecipherable pulp in order to suit present conditions.

If I do not misunderstand him, what Mr. Mivart would call developmental homogens when not true homogens should be called developmental homoplasts; *i.e.*, not only when complete, but in their mode of development, they present an agreement which is not due directly to heredity.

I remain, Gentlemen,

Truly yours,

E. Ray Lankester.

XXXIII.—*On the Skeleton of* Dioplodon sechellensis *in the Australian Museum at Sydney.* By Dr. J. E. Gray, F.R.S. &c.

Mr. Krefft has kindly sent me a photograph of a very beautifully prepared skeleton of *Dioplodon sechellensis* from an animal obtained on the coast of Australia. This animal was before known only from a skull in the Paris Museum, which was obtained by M. Leduc in 1839 in the Seychelle Islands. I figured the lower jaw and skull in the 'Zoology of the Erebus and Terror,' t. vi. f. 1, 2; and M. Duvernoy figured the skull, under the name of *Mesodiodon densirostris*, in the 'Annales des Sciences Naturelles,' 1851, vol. xv. M. Gervais also figured the skull in the 'Zoologie et Paléontologie française,' t. xliii. f. 6, under the name of *Dioplodon densirostris*; and its skull is figured under the name of *D. sechellensis* in the 'Ostéographie des Cétacés,' t. xxv. f. 2, 3, as distinct from *D. densirostris*, the end of the beak of which is figured in fig. 1 of the same plate. The name *densirostris* is used in the Paris Museum because Blainville called it *Ziphius densirostris*; but it must not be confounded with *Delphinus densirostris*, Desmarest.

The rest of the skeleton has been hitherto unknown. It is very much like that of *Ziphius Sowerbiensis*, an imperfect skeleton of the female of which is figured by M. Van Beneden under the name of *Mesoplodon Sowerbiensis* in the octavo 'Memoirs of the Academy of Brussels,' vol.

xvi. t. iii.; and a more perfect skeleton is figured in a larger size in the 'Ostéographie des Cétacés,' t. xxi. f. 1–3, t. xxii. f. 1, 2, t. xxvi.

This skeleton is very interesting as being only the second species of the family of which any other part of the animal but the skull has been observed.

The form of the lower jaw gives a very peculiar appearance to the skeleton. The cervical vertebræ are united together by their bodies and large dorsal processes, the latter forming a thick conical process. The bodies of the dorsal vertebræ are very small, enlarging in size towards the tail; they are thirty-six in number. The four terminal caudal ones are very small, forming a kind of cylindrical process. There are eight chevron bones. The thoracic cavity is small. There are twelve ribs on each side. The dorsal processes of the first eighteen vertebræ have an anterior basal process, which becomes gradually smaller.

Dr. Krefft, who has sent me a more detailed photograph of the lower jaw, has not, unfortunately, sent one of the limbs.

BIBLIOGRAPHICAL NOTICE.

An Elementary Course of Botany, Structural, Physiological, and Systematic. By Professor Arthur Henfrey. Second Edition. Revised, and in part re-written, by Maxwell T. Masters, M.D., F.R.S., &c. London: Van Voorst, 1870. Small 8vo, pp. xvi & 708. Illustrated by upwards of 500 woodcuts.

There are two points of view from which a work like the present may be regarded, either as a mere introduction to students to enable them to meet the requisitions of an ordinary examination, or as a work for higher students and a repertory of facts to which more accomplished botanists may refer occasionally to refresh or confirm the memory. Unless authors of introductions (of which it would be difficult to state the number, which is legion) bear this in mind, the general result will be sure to be a failure—a consummation which the present editor of a favourite treatise has certainly most successfully avoided. Examiners long felt that there was some great defect either in elementary treatises or in the mode of teaching botany, so far as they could judge from the answers which they elicited from students, even to the simplest questions. An utter want of accuracy, or any sufficient notion of what was before them, and, much more, any interest in the subject, seemed to show too evidently that there must be somewhere a grievous defect. The late Professor Henslow clearly indicated one great fault in elementary treatises, that physiology made too prominent a part in teaching, insomuch that the memory was loaded with a quantity of abstract notions, while the reasoning powers were utterly perplexed by contending views, none of which

seemed to indicate any thing like certainty on which the student could rest securely. Professor Henfrey was well aware of this, and says expressly in his preface that, "though his own labours have been chiefly in the field of physiological botany, he quite concurs with the opinion expressed by the distinguished authors of the 'Flora Indica,' who believe that disservice is done to the cause of botany by occupying the attention of students in the first instance with the abstract parts of the science." The editor has equally felt this with the Professor, whose views he has thoroughly carried out.

It is perhaps matter of regret that the whole work was not re-written; and, in point of fact, Dr. Masters's labours have been far greater than they would have been had the treatise been entirely original.

As regards the systematic part of the work, Dr. Masters has not followed the example of Bentham and Hooker's 'Genera,' in uniting such natural orders as Geraniaceæ, Oxalideæ, and Balsamineæ; Sapindaceæ and Acerineæ; Saxifrageæ and Ribesiæ; while *Parnassia* is referred to Hypericaceæ, instead of Saxifrageæ. In the present condition of systematic botany authors may very reasonably differ, though our own feeling is rather for what has been called the practice of "lumping" than for that of splitting. In one point we regret that Henfrey has been followed, and with the praise that his arrangement is "as natural, or more so, than any other arrangement before or since, for which reason it is retained." *Onygena*, for instance, has nothing to do with Agaricaceæ; still less have *Tuber*, *Helvella*, and *Morchella* the slightest pretension to be classed amongst Exidiaceæ, the genus *Exidia* itself being a singularly unfortunate selection as indicative of the group to which such genera as *Polyporus* belong. The Tremellinæ, of which *Exidia* is a member, ought certainly to form an order apart, being connected through the gelatinous fungus of *Juniperus sabina* with *Puccinia* and the allied epiphytous fungi, while *Puccinia* and *Æcidium* ought certainly not to be associated with Sphæriaceæ. We should also object to Lichens being put in a different class from Fungi. Their fructification is in many cases precisely the same; and it is absolutely impossible to distinguish in all cases *Verrucaria* from *Sphæria*, the only distinctive mark (of the presence of gonidia) being wanting. We greatly prefer, as has been proposed, making Lichens and Fungi two members of one large alliance.

A new edition will in all probability soon be called for, and we should suggest that the interesting subject of the peculiarities of insular floras should be more largely treated than in the two short sentences which are given to it under 922 and the following number.

We cannot end this short notice without hoping sincerely that the work will meet with the encouragement it deserves, and that it will be generally recognized as one of the most useful elementary works, especially where the student's object is something more than a mere pass.

MISCELLANEOUS.

Description of a new Species of Humming-bird of the Genus Chrysolampis. By D. G. Elliot, F.L.S., F.Z.S., &c.

Chrysolampis chlorolæma, sp. nov.

Top of head and nape of neck light metallic green, in some lights purplish; a black band across the back; rest of back and upper tail-coverts green, the longest blackish; primaries purplish brown; tail fiery copper-colour, all the feathers margined with blackish purple; throat beautiful metallic emerald-green; underparts black; flanks white; under tail-coverts rich chestnut, copper-colour in some lights; basal portions black; under wing-coverts green; bill black.

Length 4 inches, beak 0·65, wing 2·4, tail 1·3.

Hab. New Granada?

This very interesting and handsome bird appears to be a second species of *Chrysolampis*, so long represented by the well-known *C. moschitus*, or Ruby-and-Topaz Hummer, which has for many years been employed for hat-decorations &c., and is a well-known article of commerce. The present species does not at all resemble its relative as regards the colour of its plumage, inclining more to the genus *Lampornis*, among whose members, however, it cannot be included, for structural reasons. The specimen, which is unique, was received in a large collection of Hummers from New Granada; but I am unable to give its exact habitat.

Axos Cliftoni. By Dr. J. E. Gray, F.R.S.

Dr. Perceval Wright and Mr. Kent inform me that in examining some of the bark of the sponge from Nicol's Bay, which I described in the September Number (p. 272), and the slide of spicules which Mr. Clifton sent to me, they observed a very few of the double three-rayed stars which Dr. Bowerbank figured in the 'British Sponges' (fig. 197), and which I had named *Axos Cliftoni*; so that I have no doubt that *Echinospongia australis* and *Axos Cliftoni* are the same sponge. The spicules figured are exceptional forms, and seem to be imperfectly developed specimens of the hexradiate cubical spicules I have described, and which seem the characteristic spicules of the group.

Note on the Branched Variety of Squamulina scopula. By H. J. Carter, F.R.S. &c.

With reference to my description and illustrations of *Squamulina scopula*, published in the 'Annals' of May last (vol. v. p. 309, pls. 4 & 5), and my subsequent communication (*ib.* p. 389), I am now in a position to afford positive evidence, from my own observation, on two conjectural points contained in the former—viz., first, that of *Squamulina scopula* being a foraminiferous animal, and, secondly, that Dr. Bowerbank's *Haliphysema ramulosa* (Brit. Spong. vol. ii.

p. 79) is but a branched species (I should have stated "variety") of *Squamulina scopula.*

I have just now found several specimens of the branched form of *Squamulina scopula* on the rocks here (Budleigh-Salterton, Devon), growing among sponges &c. far above low-water mark, so that they are uncovered there twice every day for two or three hours at a time.

It is generally dichotomous, but by no means always so. The most perfect and largest specimen I have has eight heads. Its total length is about $2\frac{1}{2}$ twelfths of an inch, the stem before branching being $1\frac{1}{2}$, and the branched portion 1 line long by $1\frac{1}{2}$ line broad in the spread. Thus it has undergone division three times.

On cutting off the branched head with a pair of scissors across the main stem, and placing it in a watch-glass of sea-water (into which the specimen had been put on the piece of rock on which it grew, immediately on being broken off), the truncated end soon after threw out a bunch of obliquely branching and anastomosing filaments or pseudopodia, to the extent of 1-60th of an inch long, all round, which continued retracting and extending themselves and exhibiting the granule-circulation, after the manner of the sarcode of the Foraminifera, for six hours, when the whole were gradually withdrawn and did not reappear.

Thus the foraminiferous character of *Squamulina scopula* and its branched variety (which is precisely like it, with the exception of the branching) is proved.

I could not see any filaments projected from the heads in any of the specimens; nor would it be easy to do so, as these probably entwine themselves about the spicules which are always raised up from the bottom in the water; but the truncated end of the stem lay on the watch-glass, over which it was easy to see the extended filaments with a one-inch compound power.

Specimens, of course, which grow on the rocks, exposed to all the fury of the waves, are not so perfect in their spicular element as those which grow in deep and more or less still water. But the wonder is how such delicate little creatures can grow at all in such turbulent situations.

*On two Species of Land-*Planariæ *from Borneo.*

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—The figures and descriptions of the Turbellarians given by the Rev. W. Houghton in your last Number point them out as belonging to the genus *Bipalium* of Stimpson (*Sphyrocephalus* of Schmarda and *Dunlopea* of E. P. Wright in a former Number of the Annals). They are rather common forms in tropical regions. An account of their structure has been published by Schmarda, and also by M. Claparède. Their anatomy has been investigated by the writer in relation to their homologies with the Nemerteans.

I am, yours, &c.,

September 23, 1870. W. C. M'Intosh.

The large Barbet of the Himalayas in want of a Name! By Robert Swinhoe, F.Z.S.

It has been usual to refer the large Himalayan Barbet to *Bucco virens*, Scop., and *B. grandis*, Gmel., both of which names were given to a similar bird from China, for which it has been mistaken. On comparing three adult specimens from South China with three from the Himalayas, I find certain constant differences between them. I am of opinion, therefore, that the two races ought to be separated; and as both the names in use were originally applied to the Chinese bird, I would propose to dub the Himalayan species in honour of the Marshalls (Capts. C. H. T. and G. F. L.), who are now engaged in producing an excellent monograph of this family.

Megalæma Marshallorum, sp. nov.

Form and size of *Bucco virens*, Scop. (*grandis*, Gmel.), with longer bill. Feathers of head and neck marked with deep violet-blue instead of greenish azure. Lower hind neck patched with yellow, becoming smaller and confined to centre of feathers as the bird matures; in *B. virens* a few pale streaks only occur. Lesser and greater wing-coverts same colour as the back; in *B. virens* green, as on the outer webs of the secondaries, the former having a large maroon spot on each feather.

In colouring similar in other respects to *B. virens*.

Preliminary Notice of a Ziphioid Whale, probably Berardius Arnuxii, *stranded on the 16th of December*, 1868, *on the sea-beach, near New Brighton, Canterbury, New Zealand.* By Julius Haast, Ph.D., F.R.S.

Towards the latter part of December, last year, it was stated that a whale had been stranded on the sea-beach, near the mouth of the Avon. Unfortunately the notice reached me too late to enable me to see the body in its fresh state, and when I went to the sea-beach the blubber had been cut off nearly a week, and the animal was already in such an advanced state of putrefaction that the external appearance was greatly destroyed. Before entering into a description of its affinities and peculiarities, I may be allowed to offer a few observations on its capture.

Mr. William Walker, a fisherman, living near the mouth of the Avon, one mile and a half below New Brighton, observed, on the 16th of December, early in the morning, that a huge animal was in the surf, making the most strenuous efforts to return to deeper water. The fisherman had only a large sheath-knife with him, with which he stabbed it several times, making it bleed very freely. Each time when the surf reached it, it threw out a large quantity of water and sand from its blowers, like a fountain; at the same time it moved its tail with such vehemence that it threw its captor several times when he came too near it. Seeing that he could not manage the large animal by himself, he returned home to fetch a rope, a larger knife, and assistance. After having, with some trouble, placed the rope round the tail, and fastened it securely to the stump of a tree on the

beach, he inflicted with the large knife some deep wounds, from which the blood ran copiously; but the animal, notwithstanding this great loss of blood, still lived for fourteen hours. The fisherman also put a large stick several times into its mouth, which, to use his own words, made the whale "bellow like a bull."

A very interesting fact may be deduced from the observations of Mrs. Walker, who accompanied her husband on the second trip. She told her husband that each time he put the stick into the whale's mouth, she could see several large teeth in front of its lower jaw, which, however, were not observed by any body else, and the existence of which was only revealed when the skull was cleaned, when, in front of the lower jaw, two large triangular and moveable teeth on each side became exposed. It thus seems that the Ziphioid Whales, when defending themselves from their enemies, or attacking their prey, have the power to protrude these four teeth at will. Such an hypothesis gains still more in probability when we consider the nature of the principal food of the animal, which, judging from the contents of its stomach, seems to consist almost exclusively of the common sea-spider, or *Octopus*—a cephalopod which, as in the northern hemisphere, does not seem to be very numerous along the coast. In the stomach of the whale in question there was about half a bushel of the horny beaks of this cephalopod, which were nearly all of the same size. It would be rather difficult for any whale to obtain possession of such an agile animal as the *Octopus*, had not nature furnished the former with the means of taking good hold of it. It is interesting that the allied genera *Ziphius* and *Hyperoodon*, of the northern hemisphere, feed also on similar species of cuttlefish, as I learn from a paper of Dr. J. E. Gray, of the British Museum (Proc. Zool. Soc. 1868, p. 422). Also, the Sperm Whales are said to feed almost exclusively upon the same voracious animal, which, by its agility and organization, is so well adapted to make great havoc amongst the smaller inhabitants of the sea. And, as Dr. Gray justly observes, it proves, at the same time, that these cephalopods, although apparently of rare occurrence, must in many localities be very numerous, as it would otherwise be impossible to understand how they could furnish those huge whales with sufficient food.

When I proceeded to the beach the animal was still lying in the surf, partly covered with sand, but still intact. I measured its length exactly, and found it to be 30 feet 6 inches from the tip of the nose to the end of the lobes of the tail. The colour of the whole animal was of a deep velvety black, with the exception of the lower portion of the belly, which had a greyish colour. The tail was 6 feet 6 inches broad, and had the usual two falcate lobes. The pectoral fins were situated near the neck, a little above the middle of the body, and were 17 inches broad, and 19 inches long. They had a triangular form; and one of them was buried in the sand when I saw the animal first. The dorsal fin was unfortunately destroyed when I first inspected the whale, so that I cannot describe its form and position from my own observations; but Mr. Walker told me that it was small, had the usual falcate form, and was situated not far from the tail.

I may here observe that, from the form of the skull and some other

characteristics, it appears evident that this whale is the *Berardius Arnuxii* of Duvernoy, of which a specimen was caught in 1846, in Akaroa harbour, the skull of which, of the length of four feet, is at present in the Imperial Museum, in Paris. The animal to which it belonged is described as having been 32 feet long, and possessing a large dorsal fin, with a large boss or hump in front of it. As putrefaction and the cutting off of the blubber had greatly changed the outlines of the animal, I could not observe whether it possessed the larger boss in front. Mr. Walker did not speak of it when he gave me a description of the animal as it appeared when captured. However, as the figure of the skull, as given by Duvernoy in the 'Annales des Sciences Naturelles,' and copied into Dr. Gray's British-Museum 'Catalogue of Seals and Whales,' is identical with that of our own specimen, I do not hesitate to state that both belong to the same species. It also seems to me that this whale is very local, probably inhabiting only the coast of New Zealand, and perhaps the regions south of it, because, as far as I can find, it has never been observed elsewhere. It has without doubt not been met with on the coasts of Australia, or it would not have passed unnoticed, as, amongst others, the energetic director of the Australian Museum, Gerrard Krefft, F.L.S., has not observed it. I may here state that the form of the skull is very peculiar, reminding one strongly of that of a dolphin.

There seems to be nothing known of this peculiar whale, except its external appearance and its skull; and it is therefore a matter of congratulation to us that we shall be able to supply all the details of its osteological characteristics, which are peculiar in many respects.

The specimen in our possession was evidently a young animal, because all the disk-like epiphyses of the vertebræ are still detached. The same is the case with the epiphyses of the limb-bones, which are not yet united with them; also the sutures of the cranium are not yet obliterated. The beginning of coalescence is, however, to be observed in the seven cervical vertebræ, of which the first three are already anchylosed, the first two completely, and the second and third only partially, as the neural arches and transverse processes are not yet united in one bone. In the allied *Hyperoodon* all the cervical vertebræ coalesce; and it is therefore possible that when *Berardius* is in an adult state the same will take place. The *Ziphius* has six cervical vertebræ separate; and it will therefore be necessary to examine very carefully into the character of the uncoalesced vertebræ of our skeleton before giving a decided opinion upon the subject. It possesses ten dorsal vertebræ, in common with *Ziphius sowerbiensis*; the Hyperoodont whales have nine, and the dolphins thirteen to fifteen. I have not yet been able to count and examine the lumbar and caudal vertebræ, as the animal was in such a state of putrefaction that, after cleaning the bones as well as possible and leaving often a great portion of the vertebral column together, we put them at once to macerate. We obtained only one of the small pelvic bones, the other having probably been washed away by the surf; it might, however, owing to its diminutive size and sticking loosely in the flesh, easily have been overlooked. As soon as the

bones are clean, so that I can examine them, I shall offer a few more observations upon the osteology of this remarkable animal, for the complete skeleton of which the Canterbury Museum is indebted to the members of the Philosophical Institute, without whose pecuniary assistance I should have been unable to secure it for the Provincial collections.—*Proc. Phil. Institute of Canterbury, New Zealand*, May 5, 1869.

On the Heat evolved by Invertebrate Animals, especially Insects. By Maurice Girard.

M. Girard's memoir commences with a very interesting historical account of the numerous investigations that have been made upon this subject, in which he dwells especially upon the researches of Newport, the most remarkable that we at present possess. On the other hand, he is severe upon Dutrochet, to whom he thinks M. Gavaret has ascribed too much importance; and he brings to light the investigations of Dubost (1800), which have been unnoticed notwithstanding the scientific precision with which they were conducted.

M. Girard's own researches have been made by means of very various processes. He has employed the mercurial thermometer, the little bulb of which he has succeeded in introducing into the rectum of caterpillars and other insects without injury to the animal. He has also made use of the differential thermometer of Leslie, in which he made a modification necessary for his experiments. One of the bulbs presents a deep interior cavity, so that the volume of air contained in the concentric zone is equal to that of the volume of air in the other bulb. The contracted orifice is closed by a cork furnished with a tube, through which air enters and escapes freely. The insect to be experimented on is introduced into this cavity with the precautions necessary to avoid the falsification of the result. M. Girard has also employed thermo-electric needles formed of iron and copper, or, still better, of iron and platinum, such as have already, in the hands of M. Becquerel, done good service in the study of animal heat. Lastly, M. Girard has used the thermo-electric piles of bismuth and antimony, which, since their invention by Melloni and Nobili, have undoubtedly excelled all other calorimetric methods by their exquisite sensibility.

Without going into the details of M. Girard's experiments or indicating the minute precautions taken by him to render their results certain, we may indicate some of his most novel conclusions.

Adult insects, even when sleeping or very weak, never present a diminution of the temperature of the surface of their body below the surrounding temperature. The larvæ and pupæ of insects with an imperfect metamorphosis behave, in this respect, like the adults. Like them, they always present an elevation of temperature above that of the surrounding air, or at least a temperature equal to that of the latter. This is not always the case in insects with a complete metamorphosis. The author has frequently ascertained in caterpillars with smooth bodies that the surface descends below the temperature of the surrounding air, which shows that the evolution of heat by the respiratory combustion may be insufficient to com-

pensate for the loss due to superficial evaporation or cutaneous transpiration. The same fact occurs in chrysalids. The cocoon with which the pupæ of a great number of Lepidoptera and Hymenoptera envelope themselves serves to prevent a too rapid desiccation of the animal, which would superinduce a fatal superficial refrigeration. In fact, pupæ present a distinct elevation of temperature at the moment when they are taken out of the cocoon; then, in the air, they lose their weight by evaporation, and the surface of their body often descends below the temperature of the surrounding air. In winter, naked torpid caterpillars and pupæ return to the surrounding temperature or to a very slight excess above it. The superficial refrigerations due to evaporation are not produced when the temperature very nearly approaches 32° F., a result perfectly conformable with the results of physical researches.

Sex exerts a marked influence on the evolution of superficial heat in certain groups of insects. Thus in the Bombycidæ the males are warmer than the females. Something of the same kind seems to occur among the Phryganidæ and Pieridæ. But we must be careful in generalizing these results.

The experiments of M. Girard upon the differences of temperature according to the regions of the body are undoubtedly very curious. In caterpillars the heat is not localized in a few segments, but belongs to all, which agrees well with the analogous dissemination of the nervous centres. This is by no means the case in insects with powerful aërial locomotion. The variation of temperature shown by them between the thorax and the abdomen may become very considerable. In the Humble Bees, and especially in the Sphingidæ, whose flight is so powerful, the excess of the thoracic over the abdominal temperature amounts commonly to from 7° to 11° F., or even sometimes to from 14° to 18° F. We may say that in insects endowed with aërial locomotion the heat is concentrated in the thorax into a focus of intensity proportional to the effective power of flight. These results are in conformity with anatomical data. In the thorax there are the strong muscles both of the legs and wings. The latter, being in energetic contraction during flight, are the seat of an active combustion; on the contrary, the muscles of the abdomen are then inert. We must not be surprised that the equalization of temperature does not take place so rapidly as in the vertebrata. If we consider a wasp (a *Polistes* or a *Sphex*), the abdomen of which is united to the thorax only by a slender peduncle, how slowly must the currents of the blood be transmitted between these two regions through so narrow a strait! We may see how the heat developed in the thorax during the movement of flight must pass with difficulty into the abdomen, even if it ever reaches this part.

Another fact, intimately connected with that just referred to, is as follows. M. Girard has ascertained that, in the Humble Bees and *Xylocopæ*, the external evolution of heat is in relation to the buzzing. The temperature falls as soon as the insect ceases to buzz, but rises again as soon as the buzzing is resumed; and this takes place many times successively.—*Annales des Sciences Naturelles*, tome xi. (1869) p. 134; *Bibl. Univ.* January 15, 1870, *Bull. Sci.* p. 83.

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XXXIV.—*On the Larval State of* Molgula; *with Descriptions of several new Species of Simple Ascidians.* By ALBANY HANCOCK, F.L.S.*

UNTIL quite recently it was generally considered that all the Ascidians, Simple, Social, and Compound, assumed in the larval condition the tadpole form. M. Lacaze-Duthiers, however, has lately shown † that, in a certain species of the genus *Molgula* this peculiar larval condition does not exist, but, on the contrary, the young, on issuing from the egg, is a comparatively inactive Amœba-like creature, in no way resembling the usual lively tadpole-like larva, either in form or mobility. From this discovery it might be inferred (and apparently M. Lacaze-Duthiers does infer) that all the members of the genus will present this exceptional feature. Such, however, is not the case.

In 1846, M. Van Beneden published his researches on the embryogeny &c. of the Simple Ascidians ‡. This author described and figured at that time the tadpole larva of a *Molgula*, and, in fact, gave the whole history of the development of the species, which he considered new, and described under the name of *Ascidia ampulloides*. That this species is a true *Molgula* does not admit of a doubt; both the figures and description prove this, although there are one or two slight discrepancies, which may perhaps be accounted for by inaccurate observation. The head of the tadpole-like larva is represented as rather long and inclined to ovate, with the anterior extre-

* Communicated by the Author, having been read at the Meeting of the British Association held at Liverpool, Sept. 1870.

† Ann. Nat. Hist. July 1870, and Comptes Rendus, May 30, 1870.

‡ Recherches sur l'Embryogénie, l'Anatomie, et la Physiologie des Ascidies Simples (Mémoires de l'Académie Royale de Belgique, tome xx. p. 93).

mity a little constricted and produced, and the tail with the extremity furnished with a long filamentous process.

This memoir has apparently been overlooked by M. Lacaze-Duthiers; and this might easily happen, since we have seen that the species was described as an *Ascidia*.

But this is not all. We have ourselves detected the tadpole-like larva in another species of *Molgula*, which is described in the sequel of this communication, under the name of *M. complanata*. This is assuredly a true *Molgula*, having, however, one or two peculiar characters, the most striking of which is the unusual arrangement of the oviducts, which in this species pass from the posterior extremity of the genital masses, and are directed towards the dorsal region, while in all the other species of the genus they issue from the opposite extremity of the organs, and open directly into the atrium; and, moreover, the eggs are retained in the water-spaces between the branchial sac and the mantle until the larvæ are hatched. This is also a peculiar feature; for in all the other species that we have examined the eggs appear to escape at once by the excurrent tube, and to be developed externally.

There can be no mistake in regard to the fact respecting *M. complanata*, as we have taken the tadpole-like larvæ, in various stages of development, out of the water-spaces in this species. In several instances the larvæ were completely developed; and it is interesting to observe that in these instances they closely resemble in character those figured and described by Van Beneden in the memoir already alluded to. The head has the same elongated form, with the produced anterior extremity; and the tail is terminated by a similar filamentous process, which, however, when seen laterally, is found to be broad and fin-like.

Thus we have two species of well-characterized *Molgulæ* that pass through the tadpole- larval stage. Is it then really a fact that in this genus there are two distinct modes of development, as would seem to be the case from the researches of M. Lacaze-Duthiers? It may, however, be doubted whether or not the species investigated by that distinguished biologist is indeed a *Molgula*. It is named *M. tubulosa*. Now, if this be identical with *M. tubulosa* of Forbes and Hanley's 'British Mollusca,' it is certainly not a member of that genus. The *M. tubulosa* of the 'British Mollusca' is the *M. arenosa* of Alder and Hancock, described in the 'Transactions of the Tyneside Naturalists' Club' (vol. i. p. 197); but the characters of this species were, on subsequent examination, found to differ so much from those of the genus to which it had been assigned, that the late Mr. Alder and myself thought it neces-

sary to separate it generically, and to establish a new genus for its reception, to which we gave the name of *Eugyra*. This genus has not hitherto been published, but is now characterized in the following pages, and a new species of it described. It would seem probable, then, that Lacaze-Duthiers's *M. tubulosa* is no other than *Eugyra arenosa*, and consequently does not belong to the genus *Molgula*.

M. Lacaze-Duthiers's discovery, however, is not the less interesting on that account. It is a matter fraught with much importance, as it seems to establish the fact that the Tunicate organization can be developed without passing through the tadpole-condition—or, in other words, that this condition is non-essential in the development of this molluscous group. When Lacaze-Duthiers's memoir is published in full, it will be time enough to speculate on the effect his discovery may have on the recent investigations and theory of Kowalevsky respecting the relationship of the Tunicata to the Vertebrata.

I shall avail myself of the present opportunity to describe several new species of the Simple Ascidians, some of which were determined before Mr. Alder's death, others since that sorrowful event, by myself: the former will stand in our joint names; for the latter I am alone responsible.

Ascidia plana, Hancock.

Body ovate, pellucid, yellowish, smooth, except at the orifices, which are tuberculated; attached by the lower half. *Apertures* not much produced, the branchial one subterminal, the anal about halfway down. *Test* firm, rather thick, cartilaginous, smooth, hyaline, with numerous blood-channels of a yellowish flesh-colour, the terminal twigs much elongated and a little enlarged. *Mantle* rather delicate, and with the apertures not much produced. *Tentacular filaments* close-set, numerous, rather stout and long. *Branchial sac* minutely plicated, not quite so wide as the visceral mass, with short rounded papillæ at the intersections of the meshes, and small intermediate ones on the longitudinal bars. *Ventral plait* rather wide, ribbed and pectinated. Length upwards of two inches.

Two specimens of this species were dredged at Hastings by Dr. Bowerbank. It is closely related to the species next described, *A. Alderi*. The loop of the intestine, as in the latter, is placed crosswise, and the viscera are attached to the test by a membranous process that passes into the intestinal loop, just as a similar process does in that species. *A. plana*, however, is sufficiently distinguished by the number and arrangement of the tentacular filaments, the form of the branchial

papillæ, and the character of the vascular ramifications of the test.

Ascidia Alderi, Hancock.

Body irregular ovate or pyriform, produced towards the upper end, of a yellow colour, inclining to flesh-tint, with a few small scattered tubercles, attached diagonally by the base, and about halfway up the side. *Apertures* produced, distant, with longitudinal tuberculated ridges; the branchial aperture terminal; the anal about two-thirds down the body, and inclining towards the left side; ocelli red. *Test* moderately thick, firm, transparent, with the terminal twigs of the blood-channels appearing at the surface of a crimson colour, much enlarged and widely fusiform. *Mantle* rather delicate, with the apertures well produced. *Tentacular filaments* slender, distant, not numerous. *Branchial sac* minutely plicated, narrower than the visceral mass, with papillæ at the intersections of the meshes, and smaller ones on the bars between them, all having on each side a tubercular swelling. *Ventral plait* transversely ribbed and pectinated. Length upwards of two inches.

We are indebted to the Rev. A. M. Norman for the acquisition of this interesting species. Only one specimen was obtained; it was found between tide-marks at Herm, in 1865.

A. Alderi is distinguished from *A. plana*, to which it is closely related, by the arrangement of the tentacular filaments, by the form of the branchial papillæ, by the colour and peculiar character of the blood-channels of the test, and by several other minor features. This species is dedicated to the memory of my late coadjutor. I do this, with great satisfaction, at the request of its discoverer, the Rev. A. M. Norman.

Ascidia rubro-tincta, Hancock.

Body pretty regularly oval, smooth, or only very slightly wrinkled, of a pale-reddish flesh-colour, adhering by the middle portion of the side. *Apertures* distant, with the tubes not much produced, the branchial one terminal, the anal more than halfway down the side: ocelli red. *Test* rather thin, cartilaginous, pellucid, of a reddish flesh-colour, smooth, slightly wrinkled longitudinally. *Mantle* rather delicate, yellowish, tinged in parts with reddish flesh-colour; tubes short, the anal inclining backwards. *Tentacular filaments* numerous, delicate, unequal in size. *Branchial sac* minutely plicated, with rather long conical papillæ. *Ventral plait* rather narrow, strongly ribbed transversely, with the margin pectinated. Length about $2\frac{1}{2}$ inches.

A. rubro-tincta is a near ally to *A. mentula*, from which, however, it is distinguished not only by its colour, but also by several points of detail. The test is thinner and less coarse than it is in that species; and the tubes are more conspicuous, particularly the branchial one; the ventral plait, too, differs in some particulars, as well as the reproductive organs.

We have seen only one individual of this somewhat critical species; it was taken between tide-marks at Guernsey, by the Rev. A. M. Norman, in 1865.

Ascidia rubicunda, Hancock.

Body much elongated, irregularly oval, depressed, coarse, of an obscure flesh-colour, adhering by the whole side, with imperfect marginal expansions. *Apertures* a little produced, the branchial one almost sessile, terminal; the anal turned backwards from a bulging at the side, more than halfway down: ocelli small, crimson. *Test* thick, coarse, wrinkled, cartilaginous, semitransparent, of a flesh-colour, most rosy towards the apertures, occasionally overgrown with zoophytes. *Mantle* of a brilliant rose-colour, much intensified at the tubes, the alimentary tube of a greenish hue, probably from the nature of the contents; tubes distant, short, the branchial one terminal, the anal a little more than halfway down the side and turned backwards. *Tentacular filaments* short and delicate, varying in size. *Branchial sac* minutely plicated, with large conical papillæ, and intermediate ones nearly as large. *Ventral plait* transversely ribbed, finely pectinated from end to end, and of equal breadth throughout. Length upwards of 4½ inches.

This fine species was discovered by the Rev. A. M. Norman in 1866, between tidemarks at Tobermory, in the Isle of Mull, where it occurred in considerable abundance. It was also taken abundantly by the same gentleman on the stems and roots of *Halidrys siliquosa*, and procured at extreme low tides at Portaferry, Strangford Lough, 1869. More recently we have had a few specimens sent to us by Mr. A. G. More, of Dublin, who collected them in Bertraghbuy Bay, Connemara.

A. rubicunda is related to *A. mentula*, on the one hand, and to *A. robusta*, to be immediately described, on the other, but is distinguished from both by many characters. It is always more extensively attached, and is more elongated and depressed than the former, from which it likewise differs in colour. From *A. robusta* it is also distinguished by its great brilliancy of colour, as well as by its general form, its shorter tubes, and the less robust character of the test.

Ascidia robusta, Hancock.

Body elongated, irregularly ovate, produced in front, very coarse, with a tinge of red, particularly towards the apertures; adhering by the whole side; but sometimes much distorted, and with adherent root-like prolongations. *Apertures* tubular, much produced, the branchial one terminal, the anal more than halfway down and inclining backwards; ocelli red. *Test* extremely thick, tough, hard, and cartilaginous, usually with root-like prolongations, semitransparent, very coarse and rough, irregularly furrowed and pitted, and frequently much overgrown with zoophytes. *Mantle* tinged with red, deepened towards the apertures; tubes long, the anal one much produced and turned backwards. *Tentacular filaments* rather slender, not crowded, alternately large and small. *Branchial sac* extending a little behind the visceral mass, minutely plicated, with well-developed papillæ, alternately large and small. *Ventral plait* transversely and strongly pectinated near the mouth. Length 4 or 5 inches.

Several of this large coarse species were obtained, in 1865, at the island of Herm, during spring-tides, by the Rev. A. M. Norman. They were mostly so firmly inserted amidst the roots of *Laminaria digitata*, that they were with difficulty removed. It is closely related to *A. mentula* and *A. rubicunda*; the extreme hardness and thickness of the test, however, and the great length of the respiratory tubes, sufficiently distinguish it from both. From the former it is likewise distinguished by its colour and other minor characters.

Ascidia mollis, Alder & Hancock.

Body ovate, lobated, of a rosy flesh-colour, attached by a limited portion of the side. *Branchial aperture* terminal; anal from half to two-thirds down, rather inconspicuous. *Test* firm, thick, semitransparent, smooth and soft to the touch, rather shining, obtusely lobed, of a rosy flesh-colour, showing minute punctures and veinings of crimson. *Mantle* rather large in proportion to the test, of a pale flesh-colour, with a few rosy streaks; the apertures crimson. *Tentacular filaments* numerous, rather slender, varying in size. *Branchial sac* with stoutish papillæ at the intersections of the meshes, and comparatively slender intermediate ones. *Ventral plait* very narrow, strongly ribbed transversely, and pectinated at the margin.

Three or four specimens of this distinct species were dredged in 1865, in Bertraghbuy Bay, Connemara, Ireland, by Mr. G. S. Brady. And we have recently examined two more speci-

mens of it which were obtained by Mr. A. G. More, in 1869, in Kilkieran Bay, Connemara.

A. mollis is a well-marked species, and is not likely to be confounded with any known form. It can always be distinguished by the soft though firm and shining test, which, on close inspection, is observed to be marked all over with minute crimson punctures (the terminal extremities of the blood-channels, which in it are more inflated and globular than in any other species).

Ascidia crassa, Hancock.

Body broadly oval, a little depressed, deeply and irregularly wrinkled, of a pale flesh-colour, adhering by various parts to sea-weeds. *Apertures* distant, sessile; branchial one subterminal; anal about halfway down the side. *Test* very thick, hard, cartilaginous, pellucid, irregularly and strongly wrinkled, of a pale flesh-colour. *Mantle* of a rose-colour, deepened towards the margins and over the alimentary canal; the tubes short, particularly the branchial one, which is subterminal; the anal is a little produced and doubled over towards the left side. *Tentacular filaments* numerous, well-developed, unequal in size. *Branchial sac* minutely plicated, with obtuse papillæ, alternately large and small; the stomata very small and elliptical. *Ventral plait* delicately ribbed transversely, and minutely pectinated; by the side of the mouth the pectinations are increased in size, and replace the laminæ. Length $2\frac{1}{4}$ inches, breadth $1\frac{1}{2}$ inch.

We have seen three specimens of this well-marked species; they are in the collection of the Rev. A. M. Norman, and were found by Mr. Dodd on the shore at Jersey in 1869.

This species is very easily distinguished: the broadly oval form, the sessile orifices, and hard cartilaginous test are very characteristic; but the branchial sac presents probably the most distinctive feature. The walls of this organ have a very peculiar appearance, on account of the grooves of the minute plications being formed into series of small, well-defined pouches, by the close-set primary vessels, thus rendering it very difficult to observe the secondary vessels, and the unusually diminutive elliptic stomata.

Ascidia inornata, Hancock.

Body elongated, oval, depressed, attached by the whole side, of a watery horn-colour. *Apertures* a little produced, with longitudinal ridges or folds; branchial one subterminal; anal about halfway down. *Test* rather thin, cartilaginous, transparent, with a few minute papillæ and some scattered agglu-

tinated particles of sand and shell, chiefly towards the margins of attachment. *Mantle* well supplied with interwoven muscular fibres. *Tentacular filaments* numerous and rather stout. *Branchial sac* narrow, with large papillæ at the intersections of the meshes, and small intermediate ones. *Ventral plait* wide, strongly ribbed; margin pectinated, and bordered on the left side with a band of tubercles. Length nearly 2 inches.

We are indebted for the knowledge of this species to Dr. Bowerbank, who obtained a single individual of it at Hastings. It is allied to *A. plebeia*, but differs from that species in many respects, and may at once be distinguished by the narrowness of the mantle and branchial sac, and likewise by the characters of the branchial papillæ and ventral plait.

Ascidia producta, Hancock.

Body much elongated, pyriform, depressed, attached by the entire length, of a pale green colour. *Apertures* tubular; the branchial one a little produced and turned towards the ventral margin; the anal three-fourths down, near the ventral margin: ocelli red. *Test* rather thick, pellucid, cartilaginous, covered with minute, distant, conical papillæ. *Mantle* delicate, of a full dark green, with the branchial tube considerably produced, terminal; the anal short and turned backwards. *Tentacular filaments* numerous, slender. *Branchial sac* minutely plicated, with moderate-sized papillæ at the intersections of the meshes. *Ventral plait* narrow, pectinated, ribbed, and tuberculated on the left side. Length 2½ inches.

The Rev. A. M. Norman dredged this species in the Minch, in 1866, and also found it at extreme low-water during spring-tides in Strangford Lough, 1869.

A. producta evidently belongs to that group of which *A. depressa* and *A. inornata* are typical, but has many characters to distinguish it from all of them.

Ascidia elongata, Alder & Hancock.

Body elongated, slender, transparent, nearly colourless, attached slightly at the side of the base; the branchial aperture terminal, the anal about two-thirds down. *Test* hyaline, minutely tuberculated, the tubercles rather distant and pointed. *Tentacular filaments* numerous, long, and slender. *Branchial sac* with obtuse papillæ, minutely plicated; the stomata elliptical. *Ventral plait* ribbed, rather narrow. Length about two inches, breadth half an inch.

A single individual of this species was dredged in Seaham Harbour by Mr. George Hodge.

A. elongata is evidently related to *A. aculeata*, but it is

distinguished by many characters. Besides the very elongated form, the attachment is different, and the test is only slightly tuberculated; the tentacular filaments are differently arranged, and the minute structure of the branchial sac is quite peculiar, and alone sufficient for specific distinction.

Ascidia affinis, Alder & Hancock.

Body elongated, ovate, tapering upwards, semitransparent, dirty greenish white; surface smooth or only slightly wrinkled, echinated and somewhat rugose towards the base and apertures. *Apertures* prominent, large, tubular, longitudinally ridged, rugose or echinated; the branchial one terminal, the anal a little way down the ventral margin. *Test* semitransparent, thin, cartilaginous, of an obscure, pale, soiled greenish white, smooth above, and slightly roughened or echinated towards the base and tubes. *Mantle* pale olive-brown, almost colourless and transparent at the tubes, which are well-produced, wide, and strongly ribbed longitudinally, both directed upwards. *Tentacular filaments* numerous, moderately stout, alternately large and small. *Branchial sac* minutely plicated; papillæ only at the intersections of the meshes, thick, but very slightly produced. *Ventral plait* wide, smooth or only slightly ribbed at the base, margin entire; the left oral appendages seven or eight, large, triangular, flattened, and denticulated. Length upwards of two inches.

Obtained in great abundance in Roach River, Essex, by Dr. Baird, when examining the state of the river to report on its suitableness for the maintenance of oyster-fisheries. They have usually a soiled appearance, and are much infested by parasitic zoophytes, and are generally united at the base into clusters, the base being considerably prolonged, forming a sort of irregular flat pedicle.

Ascidia Normani, Alder & Hancock.

Body elongated, pretty regularly oval, white, delicately tinged with rosy flesh-colour, attached by the side of the base, transparent, strongly echinated, particularly towards the base and apertures, where the spines are usually compound. *Apertures* of a rose-colour, wide, produced, strongly ridged and echinated longitudinally; the branchial one terminal, the anal about a third down the ventral margin; ocelli small, inconspicuous. *Test* thin, transparent, white, or only slightly tinged with pale flesh-colour, covered with simple and compound spines, strongest towards the apertures and base. *Mantle* delicate, of a pale buff flesh-colour or almost colourless; the tubes well produced, and of a rosy colour. *Tentacular*

filaments rather long, white, wide at the base, distant, alternately large and small, not very numerous. *Branchial sac* minutely plicated; stomata long; papillæ confined to the intersections of the meshes, delicate, scarcely (if at all) produced. *Ventral plait* well developed, ribbed, margin entire; the left oral appendages five or six, denticulated, flat, placed diagonally. Length sometimes $2\frac{7}{8}$ inches, but usually under 2 inches.

Several of this pretty species were collected by the Rev. A. M. Norman in 1869, between tide-marks in Strangford Lough; and lately Mr. A. G. More has sent to us several specimens of it dredged by himself in Bertraghbuy Bay, Connemara. We have received it also from Mr. Robertson, who obtained three or four individuals in the Frith of Clyde.

We have named this species after our friend the Rev. A. M. Norman, to whom we are indebted for a great number of new forms of both the simple and compound Tunicata.

Genus CORELLA, Alder & Hancock, MS.

Body subquadrate or more or less rounded, coriaceous, very slightly contractile, rather compressed, attached mostly by the base. *Apertures* as in *Ascidia*; the branchial 8-lobed, the anal 6-lobed, each with small ocelli. *Test* smooth and diaphanous. *Mantle* often bright-coloured, and with a few radiating muscular fibres. *Tentacular filaments* linear, unbranched. *Branchial sac* with the secondary vessels regularly and beautifully convoluted, framed in squares formed by stout secondary rectilinear vessels and primary transverse channels. *Viscera* sinistral, the stomach placed low, with the intestine bending backwards and downwards on the left side, passing along the base of the mantle, and rising in front to the anal aperture. *Reproductive organs* also on the left side, the oviduct following the line of the intestine.

The above genus was characterized some time previously to the death of my late collaborator, Mr. Alder, for the reception of the so-called *Ascidia parallelogramma*, which differs in so many important characters from the species with which it was associated that we deemed ourselves justified in making the change. It is a sinistral animal; the alimentary tube is very differently disposed from that of *Ascidia*; the heart occupies a different position; and, above all, the spiral arrangement of the secondary branchial vessels seems sufficient to warrant the establishment of this genus.

Since then two very interesting species have been discovered which agree in all essential characters with the type form, thus justifying the separation of *Corella parallelogramma* from the genus with which it was placed.

Corella larvæformis, Hancock.

Body irregularly rounded or subquadrate, compressed, adhering by the base. *Branchial aperture* terminal, only slightly prominent; anal one at the upper part of the ventral margin, a little removed from the branchial aperture, at the extremity of a tube which is considerably longer than the entire body, and projects diagonally upwards; ocelli red. *Test* firm, smooth, shining, thin above, rather thick below, perfectly crystalline, exhibiting not only the colour of the mantle, but likewise much of the internal structure. *Mantle* delicate, adhering to the test, of a yellowish or reddish colour, with a few scattered small red spots, and so transparent that it does not in the least obscure the view of the contained visceral organs. *Branchial sac* with inconspicuous papillæ at the intersections of the meshes forming the framework of the spiral secondary vessels. *Tentacular filaments* numerous, not crowded, long, delicate, and colourless. *Ventral plait* replaced by a series of rather minute tentacular points situated a little distance apart, and corresponding in number (twelve or fourteen) to the primary vessels, dividing the rows of spirals. Length from the base to the branchial aperture ⅝ of an inch, and to the anal aperture 1½ inch.

We are indebted to Mr. A. G. More for the knowledge of this interesting and very distinct species. Two specimens were obtained at Roundstone, Connemara, in 1869.

C. larvæformis is distinguished at once from *C. parallelogramma* by the extraordinary elongation of the anal tube, and the comparative deficiency of colour, though much reliance cannot be placed on this character, as the specimens had been some time in spirit before they came into our possession. The fewness of the rows of branchial spirals, and the consequent comparative largeness of the spirals themselves, also distinguish this species.

Corella ovata, Hancock.

Body ovate, widest above, not much compressed, adhering by the base, where there are a few root-like processes. *Apertures* very little produced, almost sessile; the branchial one terminal, the anal placed at a little distance down the ventral margin. *Test* soft, smooth, delicate, and perfectly transparent, revealing the colours and structure of the enclosed mantle and viscera. *Mantle* thin, transparent, of a buff flesh-colour, sometimes with a few obscure reddish markings; tubes very short, with the margin of the apertures of a pale flesh-colour; muscles few and delicate, of a reddish colour. *Branchial sac* with thin, delicate papillæ, very slightly produced; the spirals com-

posed of only two or three stout coils. *Tentacular filaments* numerous, slender, not very long, set rather close together, in a single line on a narrow muscular band. *Ventral plait* broken up into upwards of thirty tentacular processes, which are wide at the base, attenuated upwards, and produced and pointed at the extremity. Length $1\frac{3}{4}$ inch, but usually smaller.

C. ovata was found by the Rev. A. M. Norman at low-water at Tobermory, in the island of Mull, in 1866, associated with *Ascidia rubicunda*, and adhering to *Plocamium coccineum*. It has also been found at Roundstone, Connemara, by Mr. A. G. More, occurring in clusters attached to the test of *Ascidia Normani*.

This delicate species is distinguished from its two congeners by the general form, and particularly by the character of the branchial spirals, which in *C. ovata* are not by any means so many times coiled as they are in both the other species; and the coils themselves are much stouter. In *C. parallelogramma* and *C. larvæformis* the spirals are six or seven times coiled, while in *C. ovata* they are only two or three times coiled.

Genus Ciona (Savigny), Fleming.

Body subcylindrical, gelatinous, very contractile, attached more or less by the right side. *Apertures* generally nearly terminal, and not far apart; the branchial 8-lobed, the anal 6-lobed, with conspicuous ocelli. *Test* soft, smooth, and flaccid. *Mantle* with strong longitudinal muscular bands. *Tentacular filaments* numerous and slender, linear. *Branchial sac* narrow, not reaching to the bottom of the mantle; the meshes rectilinear, with papillæ at the intersections. *Ventral plait* replaced by a series of tentacular points. *Stomach*, *intestine*, and *reproductive organs* extending below the branchial sac.

After some hesitation, and in conjunction with the late Mr. Alder, we determined to remove *Ascidia intestinalis* from the species with which it was usually associated, and place it apart as the type of a distinct genus, as Dr. Fleming had previously done, by raising Savigny's third tribe, *Phallusiæ Cionæ*, to generic rank. It is therefore satisfactory to have to record the occurrence of a new species, agreeing in all the essential characters with the type form.

Ciona fascicularis, Hancock.

Body much elongated, subcylindrical, flaccid, highly contractile, colourless, or tinged yellowish from the mantle and viscera appearing through; attached by the side of the base; the lower extremity with numerous rather long, cylindrical

papillæ. *Apertures* tubular, short, yellowish, with red ocelli; branchial one terminal, anal at a short distance down the ventral margin. *Test* soft, smooth, gelatinous, perfectly hyaline. *Mantle* delicate, pale yellow, and extremely transparent, all the visceral organs being distinctly seen through it; tubes short, cylindrical, and more highly coloured than the rest of the mantle. *Branchial sac* long, narrow, cylindrical, with rather long papillæ, non-plicate. *Tentacular points* of the ventral margin long, slender, numerous. *Tentacular filaments* numerous, long and slender, with short intermediate ones, set in a single row on a narrow scalloped fold or collar. Length from 2 to 3 inches, breadth about ½ an inch.

For specimens of this very distinct and interesting species we are indebted to Mr. A. G. More, who collected it in considerable abundance in Kilkieran Bay, Connemara, in 1869. The specimens were for the most part united towards the base into dense bundles, the upper portions being quite free. The aggregation is produced by the agency of the papillæ that clothe the sides of the basal extremity of the test; the attachment is consequently lateral. The common mass had apparently been fixed by the same means to some foreign body.

The papillæ at the posterior extremity of the test, the peculiar mode of aggregation, and the narrow cylindrical form of the body distinguish at once this species from *C. intestinalis*, from which it also differs in the respiratory tubes being further apart.

Molgula simplex, Alder & Hancock.

Body globular, subpellucid, nearly smooth, free, or very slightly attached. *Apertures* nearly terminal, not far apart, slightly tubular and retractile. *Test* rather soft, but tough, generally rather thinly clothed with linear fibrils, which are rarely forked, and seldom with any sand or shell adhering to them. *Tentacular filaments* branched, irregularly tripinnate; there are about eleven, with minute ones interspersed. *Branchial sac* with six folds on each side, the meshes distinctly but irregularly convoluted. *Ventral plait* smooth, broad below. *Intestine* forming two loops, confined to the lower half of the sac. *Reproductive organs* forming a slightly arched mass on each side, with the margins divided into numerous irregular lobes, that of the right side within the second intestinal loop. Diameter ½ to ⅝ inch.

A few specimens were found by the late Mr. Alder at Plymouth and Oban; it has also been obtained at Lough Strangford and Ballywater, Ireland, by Mr. W. Thomson. It has considerable resemblance to *Ascidia ampulloides* of Van Beneden, which is undoubtedly a *Molgula*. That species appears

to be larger than *M. simplex*, and with more extended tubes; the test, too, is described as solid and thick, which is not the case with our species.

Molgula inconspicua, Alder & Hancock.

Body globular, rather firm, covered with sand and shell, unattached. *Apertures* approximated. *Test* tough, clothed with irregular linear fibrils. *Mantle* rather thick and muscular towards the upper part, thinner below, the intestine showing through. *Tentacular filaments* bipinnate. *Branchial sac* with six folds on each side, the meshes very slightly convoluted or almost linear. *Ventral plait* smooth. *Intestinal canal* large, reaching nearly to the top of the sac, twice looped. *Liver* dark, obscure green. *Reproductive organs* forming a long, curved, elliptical mass on each side, with the margins divided into irregular lobules, that on the right side within the second intestinal loop. Diameter $\frac{3}{10}$ inch.

One specimen only has come under our notice; it was dredged in Guernsey by Mr. Jeffreys and the Rev. A. M. Norman in 1865.

This rather obscure species is remarkable on account of the nearly linear arrangement of the branchial meshes, which, however, preserve sufficient curvature to bear out the character of the genus to which it belongs. It is nearly allied to *M. simplex*, from which it differs in the character of the branchial meshes already noticed, as well as in the less bushy tentacular filaments and the more voluminous intestine.

Molgula complanata, Alder & Hancock.

Body much depressed, rather longer than broad, adhering by its whole length, covered with sand and small fragments of shell. *Apertures* at a little distance apart; the branchial one towards the margin, the anal about the centre of the disk. *Test* rather thin, covered with long simple fibrils, to which the sand is attached; under surface very thin and smooth, with only a few grains of sand. *Mantle* transparent, slightly attached to the test, and with strong radiating muscles round the apertures. *Tentacular filaments* simply pinnate. *Branchial sac* with six folds on the right side and seven on the left; the meshes a good deal convoluted. *Intestinal canal* forming a single long loop. *Liver* pale green, folded or laminated. *Reproductive organs* composing an oblong ovate mass on each side; that on the right side placed immediately above the intestinal loop; the oviducts turned to the posterior side. Length $3\frac{1}{2}$ tenths of an inch.

We have seen only one specimen of this well-characterized species. It was adhering to the inside of a dead shell of *Patella vulgata* dredged in Guernsey by Mr. Jeffreys and the Rev. A. M. Norman in 1865.

The depressed form and large surface of attachment in this little *Molgula* are characters very unusual in this genus. Another peculiarity is observed in the reversed position of the oviducts.

Genus Eugyra, Alder & Hancock, MS.

Body globular, unattached, covered with glandular fibrils and a coating more or less complete of fine sand. *Test* usually thin and transparent, hispid. *Branchial aperture* 6-lobed, anal 4-lobed, placed on slight tubes, nearly inconspicuous when contracted. *Tentacular filaments* branched. *Branchial sac* without folds, but with longitudinal plates or bands; the meshes regularly convoluted and produced into little cones, each being composed of a double spiral coil of vessels, which spirals, turning in opposite directions, meet at the apex. *Reproductive organs* in a single mass placed on the right side within the intestinal loop.

Molgula arenosa varies so extensively from the other *Molgulæ* that we thought it necessary to place it in a genus apart. This we did several years ago in our MS., and characterized the genus as above. Since then, another species of *Eugyra* has been discovered, and has now to be recorded.

Eugyra globosa, Hancock.

Body globular, unattached, entirely covered with sand and fragments of shell. *Apertures* not quite terminal, a little apart, somewhat produced, rather wide, cylindrical, resembling a pair of teats, colourless, transparent, placed in a well-defined, bilobed, narrow area, devoid of attached sand. *Test* soft, thin, with very delicate and for the most part simple fibrils. *Mantle* thin, colourless, or slightly tinged with yellow, transparent, the viscera showing through; tubes hyaline, with delicate membranous walls. *Branchial sac* with the vessels of the double spiral coils rather stout. *Intestine* forming a single loop, short and constricted towards the anal extremity, and widening at its junction with the stomach. *Liver* bulky, of a black olive-green. *Reproductive organs* of a pale yellow, placed partly within the intestinal loop, and partly above it. Diameter half an inch.

A single specimen of this interesting species was dredged by Mr. Jeffreys and the Rev. A. M. Norman in Guernsey in 1865. *E. globosa* is distinguished from *E. arenosa* by the

form and larger size of the tubes, by the less voluminous intestine, by the shortness of its loop, and by the darkness and colour of the liver.

XXXV.—*On* Georissa, Acmella (Cyclostoma tersum, *Bens.*), Tricula, *and* Cyathopoma millium, *Bens.* By WILLIAM T. BLANFORD, F.G.S., C.M.Z.S.

DR. V. MARTENS, in the 'Malakoz. Blätter' for 1869*, p. 223, has pointed out that I was in error (Ann. & Mag. Nat. Hist. March 1869, p. 177) in supposing *Hydrocena* of Parreyss to be a marine shell, and, consequently, that the only essential ground of distinction between it and my genus *Georissa* disappears. I had overlooked Frauenfeld's mention of the shell in the 'Verhandl. der zool.-bot. Gesellschaft' for 1866 until after sending off my note, and at the time of writing was mainly guided by Martens himself (conf. Malakoz. Blätter, 1864, p. 142, and Ann. & Mag. Nat. Hist. 1866, vol. xvii. p. 202) in rejecting Küster's habitat. I fully agree that there is no further reason for distinguishing the genera, and that *Georissa sarrita*, *frustillum*, *pyxis*, *Rawesiana*, and *illex* must be restored to the genus *Hydrocena*. At the same time it is very desirable that the animal of *H. cattaroënsis* should be reexamined with regard to the position of the eyes and the mode of carrying the operculum; and it is only proper to add that I had myself observed the animal of *H. pyxis*, Bens., and found it very similar to *H. sarrita* as figured by Major Godwin-Austen, and very different from *H. cattaroënsis* as figured by Küster.

I cannot, however, coincide with Dr. v. Martens in his opinion, founded solely on Major Godwin-Austen's drawings, that *Cyclostoma tersum*, Bens., is an *Assiminea*; and I am persuaded that an inspection of the shell would very soon undeceive my critic. *C. tersum* possesses a very distinct sculpture, whilst *Assimineæ* are always, so far as I have seen, smooth; and whereas every species of true *Assiminea*, so far as I am aware, is an estuarine shell, living between tide-marks on mud, the little shell from the Khasi hills is found, as I am informed by Major Godwin-Austen, in company with *Pupa plicidens*, in moist places near small streams, but not upon their edges, at a height of 4000 feet above the sea.

The only species of *Acicula* which I possessed for comparison with *C. tersum* was *A. spectabilis*, Rossm., which is similar

* But, as is only too frequently the case, published some months after the close of the year.

in structure and sculpture; and, as I pointed out, *Cyclostoma striata*, Quoy and Gaimard, referred by Gray and Pfeiffer to *Acicula*, appears to resemble *Cyclostoma tersum* in many of its characters.

If, as Martens thinks, and I am on the whole disposed to agree with him, I was wrong in assigning *Cyclostoma tersum* (or, as I proposed to call it, *Acmella tersa*) to *Acicula*, what is its generic position? It certainly is no *Assiminea*; but it may be allied; and if so, it becomes simply a land Rissoid*. It is, of course, to be regretted that Major Godwin-Austen did not succeed in isolating the very minute teeth of the lingual ribbon and figuring them separately, as the presence or absence of basal denticles on the central tooth would have aided in deciding the question; but since last year I have some further evidence, which is in favour of *Acmella* belonging to this ubiquitous family.

Major Godwin-Austen obtained a shell in North Cachar which he considered to be a second species of *Acmella*. It was found on wet moss beside a waterfall, in a stream flowing into the Jhiri river, at an elevation of about 3000 feet above the sea. On examining and comparing the shell, I found it to be identical with *Tricula montana*, Bens. Major Godwin-Austen has figured the operculum and lingual ribbon, but his figure shows only the edges of the teeth: they are evidently tænioglossate, as might be expected, and have a general resemblance to those of *Acmella tersa*; but they are broader, the second lateral very much so. The operculum is thin, horny, and paucispiral, and presents apparently no essential distinction from that of *Acmella*.

Tricula montana was first found by Mr. Benson† on water-plants in a stream at Bheemtal, in Kumaon (Western Himalayas), at an altitude of 4000 feet above the sea. I have also received it from Naini Tal, in the same neighbourhood, at a rather higher elevation. Its range is widely increased by Major Godwin-Austen's discovery.

Certainly *Acmella tersa* shows a very close correspondence with *Tricula montana* in the structure of the shell; but the eyes in the latter are described by Mr. Benson as being behind the base of the long filiform tentacles ("tentaculis filiformibus duobus oculos postice prope basin gerentibus")—precisely as in *Acicula*, in short. Moreover *Tricula* is evidently a fresh-water shell, living in streams, whilst *Acmella* is a land-shell.

* It appears to me far from improbable that *Acicula* itself belongs to the *Rissoidæ*.

† Calcutta Journal of Nat. Hist. 1842. Ann. & Mag. Nat. Hist. Dec. 1862.

It is evident that the two must be distinguished; and if I am wrong in considering *Acmella* a subgenus of *Acicula*, I should be equally in error in proposing to subordinate it to *Tricula*. The latter has, by Stimpson (Researches on the *Hydrobiinæ*, &c.) and Stoliczka (Palæontologia Indica, v. p. 271), been referred to the Rissoidæ; but Stoliczka places it in a different subfamily from *Assiminea*. I have very little doubt that this position is correct; and the conclusion at which I have arrived is that *Cyclostoma tersum*, Bens., belongs to the Rissoidæ, that it is allied to *Tricula* and also, probably, to *Acicula*, but that it must be considered the type of a distinct genus, thus characterized:—

Acmella, gen. nov.

(Subgen. nov., Ann. & Mag. Nat. Hist. 1869, ser. 4. vol. iii. p. 178.)

Testa ovata, cornea; apertura ovata; peristomate obtuso.

Operculum corneum, tenuissimum, paucispirale; nucleo excentrico, sinistrali.

Animal *Assimineæ* simile; proboscide brevi; tentaculis brevibus, obtusis, oculos insuper haud procul ab extremitatibus gerentibus; pede mediocri, ovato.

Species unica typusque:—

Acmella tersa (Bens.).

Cyclostoma tersum, Bens. Ann. & Mag. Nat. Hist. 1853, ser. 2. vol. xi. p. 285.

Hydrocena tersa, Pfr. Mon. Pneum. ii. 158, iii. 172.

Since last year, Major Godwin-Austen has obtained a second species of *Cyathopoma* from the ranges south of Assam, which agrees much better with Mr. Benson's description of *Cyclostoma milium* than that first found; it, however, has spiral sculpture. It thus appears more than ever probable that *C. milium* is a *Cyathopoma*, and possibly a worn specimen of the shell last found, in which the sculpture had been abraded.

XXXVI.—*On the Genus* Climacograpsus; *with Notes on the British Species of the Genus.*

By Henry Alleyne Nicholson, M.D., D.Sc., M.A., F.R.S.E., &c., Lecturer on Natural History in the Extra-Academical School of Edinburgh.

The genus *Climacograpsus* was originally founded by Hall, the eminent American palæontologist (Grapt. Quebec Group, p. 111) to include certain species of Graptolites which had

previously been placed under the genus *Diplograpsus.* He also included under this head certain other forms, which he referred to a subgenus, under the name of *Dicranograpsus.* This subgenus, however, should unquestionably have the rank of a distinct genus, having for its type *D. ramosus*, Hall; and some of the forms placed under it by its originator (viz. *D. sextans* and *D. divaricatus*) should properly be removed to the genus *Didymograpsus* of M'Coy.

The genus *Climacograpsus* was defined by Hall as follows:—

> "Simple stipes with subparallel margins, having a range of cellules on each side; axis filiform; cellules short and square; apertures apparently excavated in the margin of the stipe, and transversely oval or subquadrate; cell-denticles or appendages, if present, usually on the upper side of the aperture."

The essential point of this definition, whereby *Climacograpsus* is fundamentally distinguished from the closely allied genus *Diplograpsus*, is that the cell-apertures are situated in a hollow, which is scooped out of the margins of the polypary. The cell-apertures are placed, therefore, below, or internal to, the general boundary of the frond (fig. 1 *a*), and they are not placed at the end of tooth-like "denticles," as in *Diplograpsus.* In lateral views of *Climacograpsus*, where the frond is simply compressed, or is exhibited in section (as in fig. 1 *a*), this arrangement is particularly conspicuous, the cell-apertures appearing as a number of rounded or subquadrate notches sunk below the general level of the polypary. It was upon specimens such as these that Professor M'Coy founded his *Diplograpsus rectangularis* (Pal. Foss. p. 8, pl. 1 B. fig. 8). Judging, also, merely from examples of this nature, it would certainly be supposed that the cellules of *Climacograpsus* were not separated one from another by distinct cell-partitions. It was pointed out, however, by Salter that it was often possible to trace from the base of each cell-mouth a short impressed line, extending nearly as far as the next cell-mouth below (Quart. Journ. Geol. Soc. vol. viii. p. 389, pl. 21. figs. 3 *b*, 4 *b*). That this line is truly the edge of a cell-partition is shown conclusively by an examination of specimens preserved in relief (fig. 1 *c*), of which the Coniston Mudstones have yielded to me a magnificent series. From these specimens it becomes at once evident that the cellules in *Climacograpsus* are really as distinct from one another as in *Diplograpsus*, each cellule being bent so that its outer portion becomes parallel with the axis of the frond, thus bringing the cell-mouth directly beneath the cellule immediately above. The foreshadowing of this

arrangement of parts is shown in certain of the *Diplograpsi* (*e. g.* in *D. putillus*, Hall, and *D. tamariscus*, Nich.). Upon the whole, then, *Climacograpsus* differs from *Diplograpsus* merely in the fact that the cell-apertures are not placed at the extremity of projecting denticles. This difference is not, perhaps, one of great structural importance; but it communicates such a peculiar aspect to the whole group of the *Climacograpsi* that for the present the distinctness of the genus may well be maintained.

Taking *Climacograpsus teretiusculus*, His., as the type, the following may be described as the structure of the genus, though it is probable that some of the species differ from this in respects more or less important:—

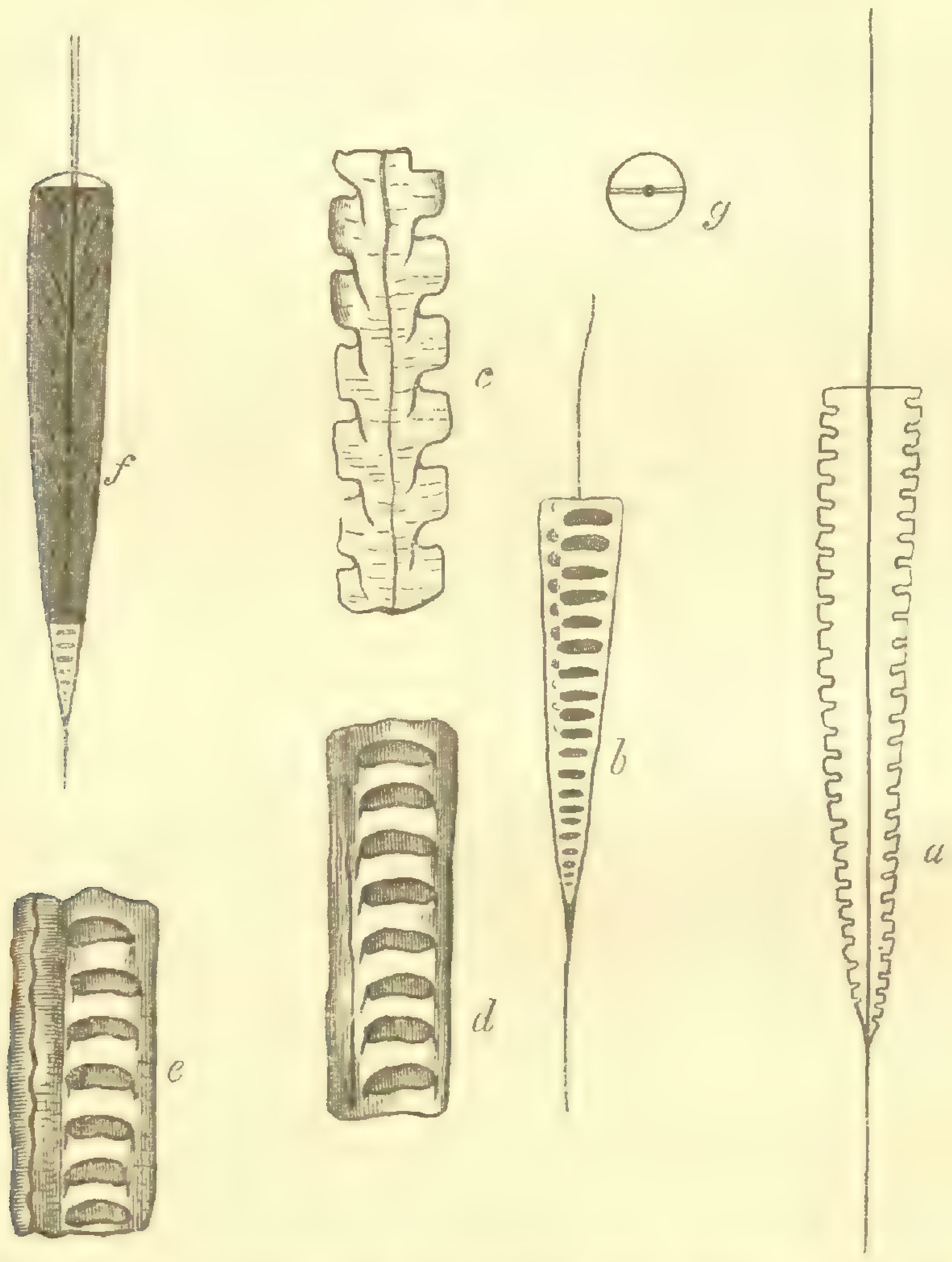
The frond (fig. 1) is diprionidian, having cellules on each side, and is cylindrical in shape, tapering more or less rapidly towards the base. It is composed of two simple unicellular stipes placed back to back, their internal or dorsal walls coalescing to form a single vertical septum (fig. 1 *g*), along the centre of which runs a delicate solid axis, in the form of a fibrous filiform rod. Along the lateral margins of the frond (or the margins furthest removed from the solid axis) open the cell-mouths, forming a row on each side. The solid axis is always prolonged as a naked rod beyond the distal end of the frond; and there is almost always a similar extension beyond the proximal extremity.

In order to comprehend fully the structure of *Climacograpsus teretiusculus*, it may be advantageously compared to an ordinary lead-pencil. Such a pencil, when taken to pieces, is found to consist of two longitudinal semicircular halves, applied to one another by their flat surfaces, and having the lead running through the centre as a median rod. This is almost exactly the structure of *C. teretiusculus*. Each half of the pencil corresponds to one of the stipes composing the frond, the lead represents the solid axis, and the glue cementing together the two halves of the pencil may be taken to represent the vertical septum formed by the coalescence of the two internal walls of the stipes. To make the analogy complete, we have only to suppose that the pencil tapers gradually towards one of its ends, whilst the lead should be prolonged beyond one or both extremities, and a row of transverse openings should exist on the convex side of each of the lateral halves.

The correctness of this view of the structure of *Climacograpsus teretiusculus* is conclusively proved by an extensive suite of specimens, preserved in relief, which I have obtained from the Mudstones of the Coniston series of the north of

England. These specimens, as I have elsewhere mentioned (Quart. Journ. Geol. Soc. vol. xxiv. p. 529), very readily split up, entirely or partially, into their component halves—thus exhibiting the structure of the frond in an exceedingly beau-

Fig. 1.



a. Specimen of *Climacograpsus teretiusculus*, His., showing the notch-like cell-apertures and the distal and proximal extensions of the axis; twice the natural size: from the Upper Llandeilo Shales of Dobb's Linn, near Moffat. *b*. Specimen of the same in a scalariform view, showing the mouths of the cellules; twice the natural size: Upper Llandeilo, Garple Linn, near Beattock. *c*. Specimen of the same in relief, showing the cell-partitions and suture; much enlarged: Coniston Mudstones, Skelgill Beck, near Ambleside. *d*. Fragment of a scalariform specimen of the same, much enlarged: Dobb's Linn, near Moffat. *e*. Another fragment, greatly enlarged: Skiddaw Slates. *f*. A specimen in relief, but split in half till close upon the base, showing the median septum and the solid axis running along its centre; twice the natural size: Mudstones of the Coniston series. *g*. Transverse section of a specimen of *C. teretiusculus*, preserved in the round, showing the median septum and the solid axis.

tiful and instructive manner. One of these specimens I have figured (fig. 1 *f*); and the only other point about them which is worthy of notice is the very general presence in the median septum of oblique lines running from the axis towards the margins of the stipe. The exact nature of these oblique corrugations I have hitherto been unable to make out.

Whilst the above is unquestionably a correct interpretation of the intimate structure of the frond of *C. teretiusculus*, it would appear that some, at any rate, of the other members of the genus differ very materially from this type. With regard to most of the *Climacograpsi*, we have absolutely no certain knowledge of their structure; and the appearances which they ordinarily present are so like those exhibited by *C. teretiusculus* that we may almost unhesitatingly assume an identity of structure. This, at any rate, is the case with *C. bicornis*, Hall, *C. tuberculatus*, Nich., and *C. innotatus*, Nich. In the case, however, of *C. typicalis*, Hall, a species not yet recorded as British, there appears to be a different disposition of parts. It would appear, namely, from the researches of Hall (Grapt. Quebec Group, p. 28, pl. A. figs. 1–9) that in this species there is no median septum dividing the frond into two separate and independent moieties, but that there is a central, rod-like, solid axis running up the centre of a tube common to the two series of cellules. The absence of the median septum may safely be doubted, and is certainly not demonstrated by any of Hall's hitherto recorded observations; but another point of great importance seems to have been fairly proved beyond reasonable doubt—namely, the fact that the cell-partitions absolutely reach the solid axis, to which they are actually attached. Assuming this to be the case (as it certainly is not in most of the *Climacograpsi* and *Diplograpsi*), the communication of the separate cellules with one another can only be accounted for by Hall's hypothesis that the cell-partitions are in the form of triangular plates, having their apices attached to the solid axis, and having "an unequally arched or convex upper surface, and a concave lower surface." On this assumption, and apparently on no other, can we conceive of the separate polypites being connected by a cœnosarc. In *C. teretiusculus*, as I have before said, the specimens preserved in relief in the mudstones of the Coniston series demonstrate unequivocally the existence of cell-partitions. I am enabled, however, to add that some of these specimens, which exhibit hollow casts of the interior of the frond, show in the most conclusive manner that in this species the cell-partitions did *not* reach the solid axis, but are, on the contrary, separated from the median septum by a very well-marked "common

canal" for the conveyance of the cœnosarc. This is also the structure in all the *Diplograpsi* which I have had an opportunity of examining in a sufficiently good state of preservation.

From the peculiar nature of the cellules in *C. teretiusculus*, and in all other members of the genus *Climacograpsus*, it will be at once seen that all the views of the frond which can possibly be obtained appear to be more or less "scalariform." The cellules are so welded together that their mouths are sunk below the general surface, and are separated by more or less tumid interspaces; hence the impossibility of ever obtaining views which show lateral serrations or denticles, as in the *Diplograpsi*. As in all other cases, however, the appearances presented by any given specimen vary with the surface of the cylindrical frond which may happen to be exposed to view. If a lateral view is exhibited (fig. 1 *a*), we find the cell apertures as rounded or nearly square notches along each side. Along the centre, between the rows of notches, is a straight or slightly undulating impressed line, which I have termed the "suture," and which is constituted, not by the solid axis, but by the edge of the median septum dividing the two halves of the cylinder. From each notch (fig. 1 *c*) is directed downwards and inwards, in well-preserved examples, a short impressed line, which is really the edge of a cell-partition; and between the bases of these and the "suture" is a narrow plain space indicating the position of the common canal. This view of *C. teretiusculus* was originally described by M'Coy as a distinct species, under the name of *Diplograpsus rectangularis*. If, on the other hand, either of the two surfaces on which the cellules open be exposed, we get the appearances shown in fig. 1 *d*, *e*. We get, namely, an impression bounded by perfectly plain lateral margins and exhibiting a number of transverse, lunate or elliptical slits or apertures. This is a true "scalariform" view, in the sense in which we use the term as applied to a monoprionidian species. In well-preserved specimens exhibiting this view, two faint lines proceed outwards and downwards, one from each angle of the transverse aperture, marking the position of the cell-partitions. The "suture" may be exhibited if the view is slightly oblique (as in fig. 1 *e*); but very often the suture is wholly invisible (fig. 1 *d*). The solid axis is, of course, not visible directly, except beyond the two extremities of the frond proper; but it is not uncommonly traceable in much compressed specimens; and in these, too, it is far from infrequent for the apertures of the row of cellules on the opposite side of the frond to be seen indistinctly through the test. Between these extreme terms

(as shown in fig. 1 *a* & *b*) intermediate forms exist in great variety, varying in every possible way with the exact portion of the surface of the frond which may be exposed to view.

The entire genus *Climacograpsus* appears, in Britain at any rate, to be exclusively confined to the lower division of the Silurian rocks. In the Skiddaw Slates three of the five British species have been detected by myself, namely, *C. antennarius*, Hall, *C. bicornis*, Hall, and *C. teretiusculus*, His. In the Upper Llandeilo rocks we have *C. teretiusculus*, *C. bicornis*, *C. tuberculatus*, Nich., and *C. innotatus*, Nich., the two former being highly characteristic of the formation. In the Caradoc rocks only *C. teretiusculus* has hitherto been detected; but it is extremely abundant in some portions of this series. Above the Caradoc rocks the genus is represented solely by a single example of *C. teretiusculus*, discovered by Professor Harkness in the Lower Llandovery rocks of Haverfordwest.

Climacograpsus teretiusculus, His., sp.

Prionotus teretiusculus, His. Leth. Suecica, Supp. 2, t. 38. fig. 4.
Diplograpsus rectangularis, M'Coy, Ann. Nat. Hist. ser. 2. vol. v. p. 271; Pal. Foss. p. 8, pl. 1 B. fig. 8.
Diplograpsus teretiusculus, Salt. Quart. Journ. Geol. Soc. vol. viii. pl. 21. figs. 3, 4.
Climacograpsus teretiusculus, Nich. Quart. Journ. Geol. Soc. vol. xxiv. p. 139, pl. 5. figs. 11–13; *ibid.* pp. 528, 529.
Climacograpsus scalaris, Carruthers, Geol. Mag. vol. v. p. 131.
Climacograpsus minutus, Carruthers, *ibid.* p. 132.

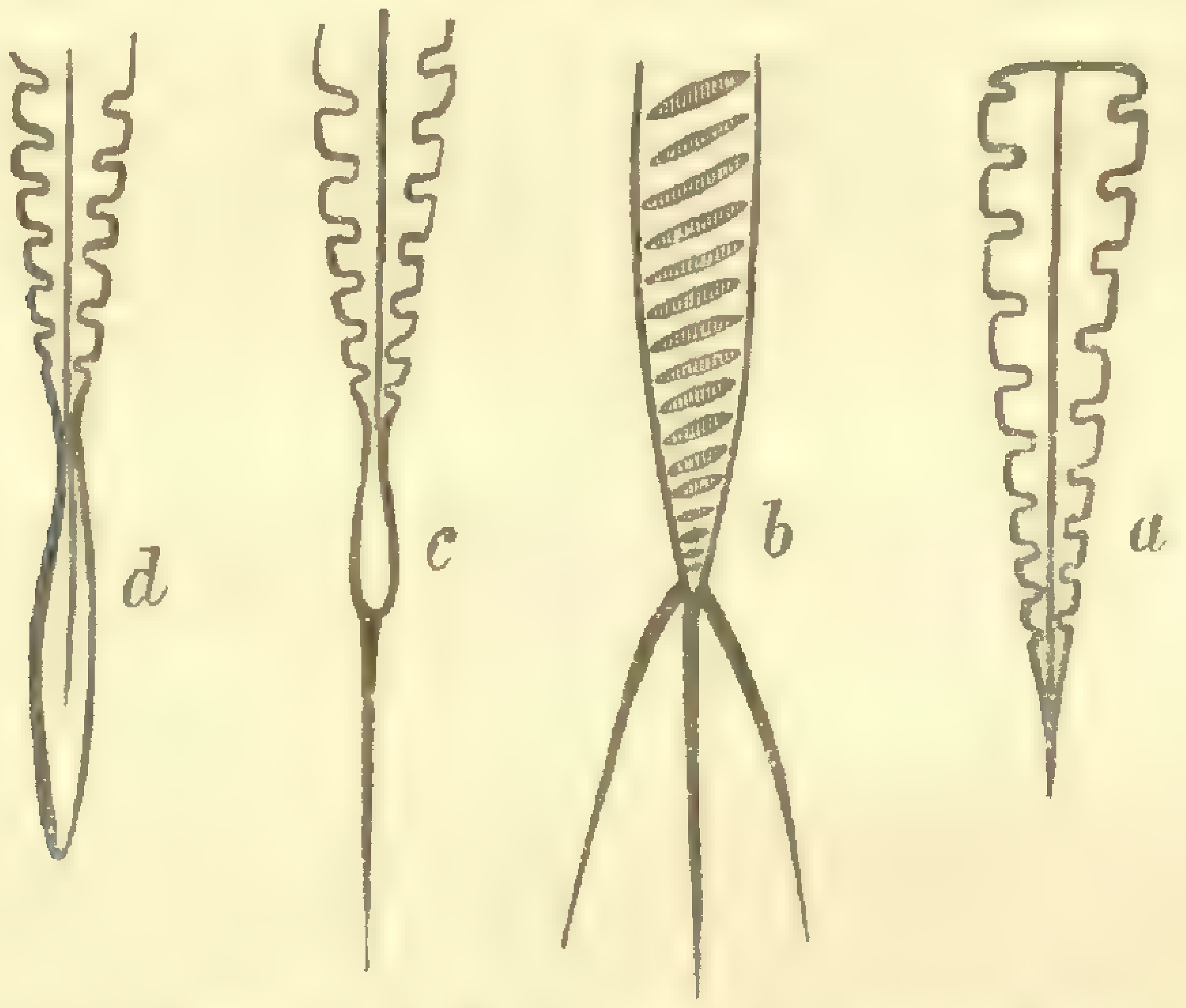
Having already described the appearances which are ordinarily presented by this species, it will not be necessary for me to do more here than simply to notice the characters of the base, as it is by these that *C. teretiusculus* is distinguished from the closely allied *C. bicornis*.

In normal specimens of *C. teretiusculus* the solid axis is prolonged proximally below the base of the frond for a greater or less distance in the form of a filamentous cylindrical radicle. This is the ordinary condition of the base; and the only variation in this respect which is at all common relates to the length of the proximal extension of the axis. In a great many individuals (fig. 2 *a*) the radicle is extremely short, not exceeding from ½ to 1 line or 2 lines, and this though the frond may be from ½ to 1 inch in length or even more. In other individuals, again (fig. 1 *a*, *b*), the length of the radicle is much greater, varying from ¼ inch to as much as 1½ inch, the frond itself reaching sometimes a length of as much as 2½ inches. These variations, however, are probably due merely to the age of any given individual.

Several departures, however, from the above simple state of

the parts are observable. In the first of these (fig. 2 *b*), whilst the radicle or proximal extension of the axis retains its normal characters, there are superadded to this two long lateral spines, which may be as long as the radicle itself. The specimens which exhibit this peculiarity are in no other respect different from typical examples of *C. teretiusculus*, and they are strictly comparable to an analogous variety of *Diplograpsus pristis*, which sometimes occurs in the same beds. The presence of three basal processes brings this form into close relation, also, to one of the varieties of *C. bicornis*, Hall; but the central radicle in the latter is always very short, or is even quite

Fig. 2.



a. Base of the common form of *C. teretiusculus*, with a short radicle: Coniston Mudstones. *b*. Base of the same, showing a long median radicle and two long lateral spines: Upper Llandeilo, Dobb's Linn, near Moffat. *c*. Base of the same, showing the commencement of the radicle enveloped in a sheath: Upper Llandeilo, Hart Fell, near Moffat. *d*. Base of the same, showing the radicle swelling out below into a species of vesicular dilatation: Upper Llandeilo, Garple Linn, near Moffat. All much enlarged.

rudimentary. A second peculiarity, first noticed by Mr. Carruthers (Intellectual Observer, June 1867), consists in the fact that whilst the filiform radicle may be prolonged for an inch or more below the body of the frond, its upper extremity is enclosed, for the space of a line or thereabouts, in a tubular sheath derived from the proximal end of the frond (fig. 2 *c*). In the third variety (fig. 2 *d*) the proximal extension of the axis is slender at its commencement close to the base of the frond, but gradually dilates into a long narrow vesicular body, which is elliptical or fusiform in shape, and may attain a length of nearly five lines with a breadth of more than half a line. This singular variation, though not of very common occurrence, cannot be looked upon as accidental.

Before leaving *C. teretiusculus*, I cannot forbear making a few remarks upon the circumstances which have induced some modern observers to substitute the specific name of *scalaris* for that of *teretiusculus*. The name *Graptolithus* was originally applied by Linnæus to certain natural objects most of which were certainly not Graptolites, and which he himself did not believe to be true fossils at all. In the twelfth edition of the 'Systema' (Stockholm, 1768) there is to be found a description of a fossil termed by Linnæus *Graptolithus scalaris*, the exact nature of which has formed a subject of some controversy. This so-called *G. scalaris* was originally described by Linnæus and figured in his 'Scanian Travels' (Skanska Resa), which were published in 1751. I have not at present an opportunity of reproducing the original figure of Linnæus; but I subjoin a copy of the facsimile of the same given by Geinitz (Die Graptolithen, t. 6. fig. 20), which will be accurate enough for all practical purposes (fig. 3).

Fig. 3.

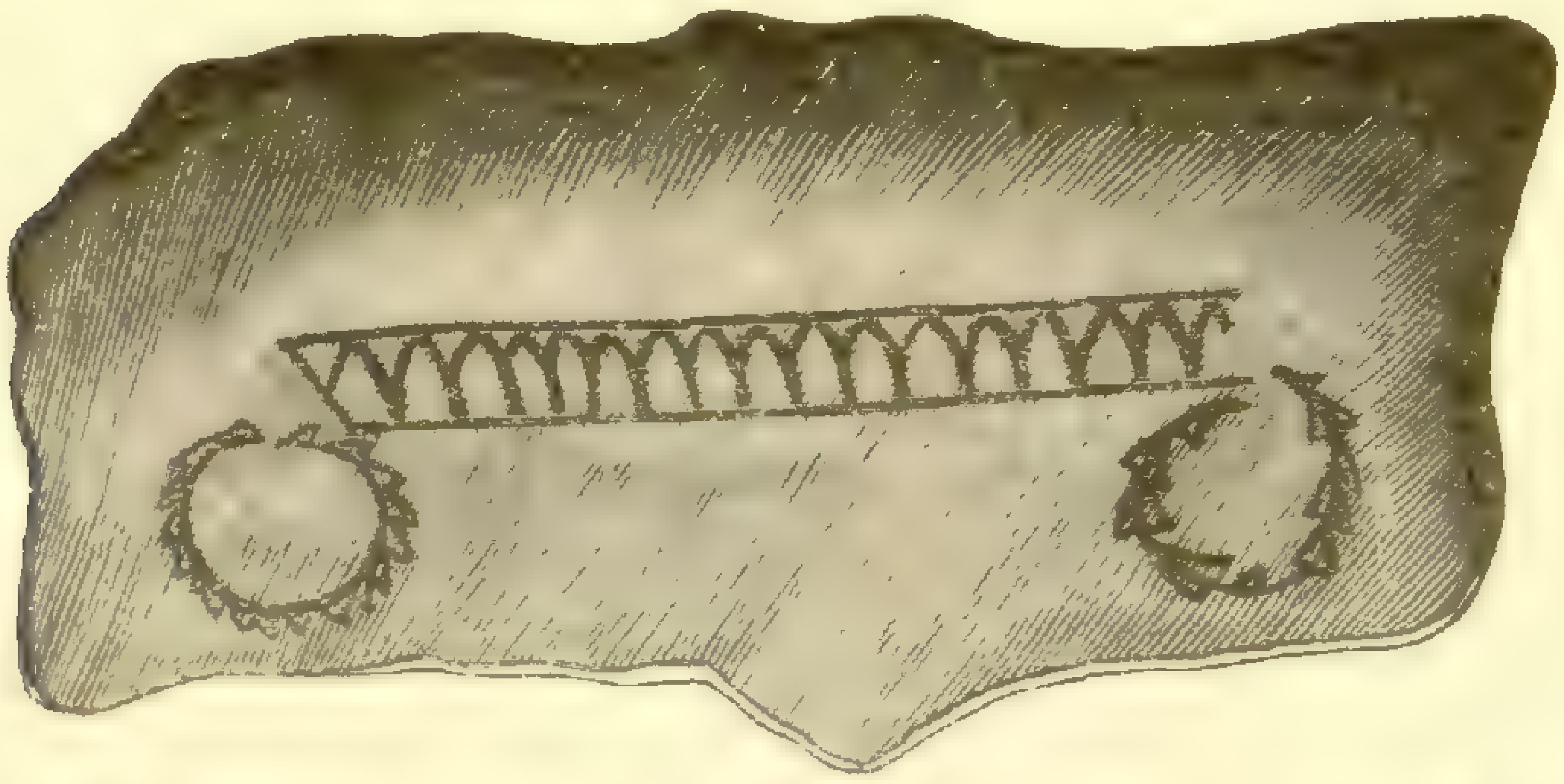


Figure of *Graptolithus scalaris*, Linn., after Linnæus. From 'Skanska Resa,' p. 147. Copied from Geinitz.

From this figure it will be seen that two wholly dissimilar objects are represented in this primitive sketch. The two spiral bodies are unquestionably Graptolites, and may very possibly be referable to the base of the species now known as *G. Sedgwickii*, Portl. The straight body, however ("lineam striasque transversas referens") is the original *G. scalaris*; and a rather unfruitful controversy has been carried on as to its exact nature. The question, however, is not wholly unimportant, as changes in our nomenclature have been advocated on the basis of the supposed nature of this figure.

By Wahlenberg, Geinitz, and Barrande, *G. scalaris*, Linn., is regarded as a unicellular or monoprionidian Graptolite (viz. *G. sagittarius*) compressed in a direction rectangular to the cellules, so that the apertures of the cellules are shown running across the stipe transversely. Upon this view the term "sca-

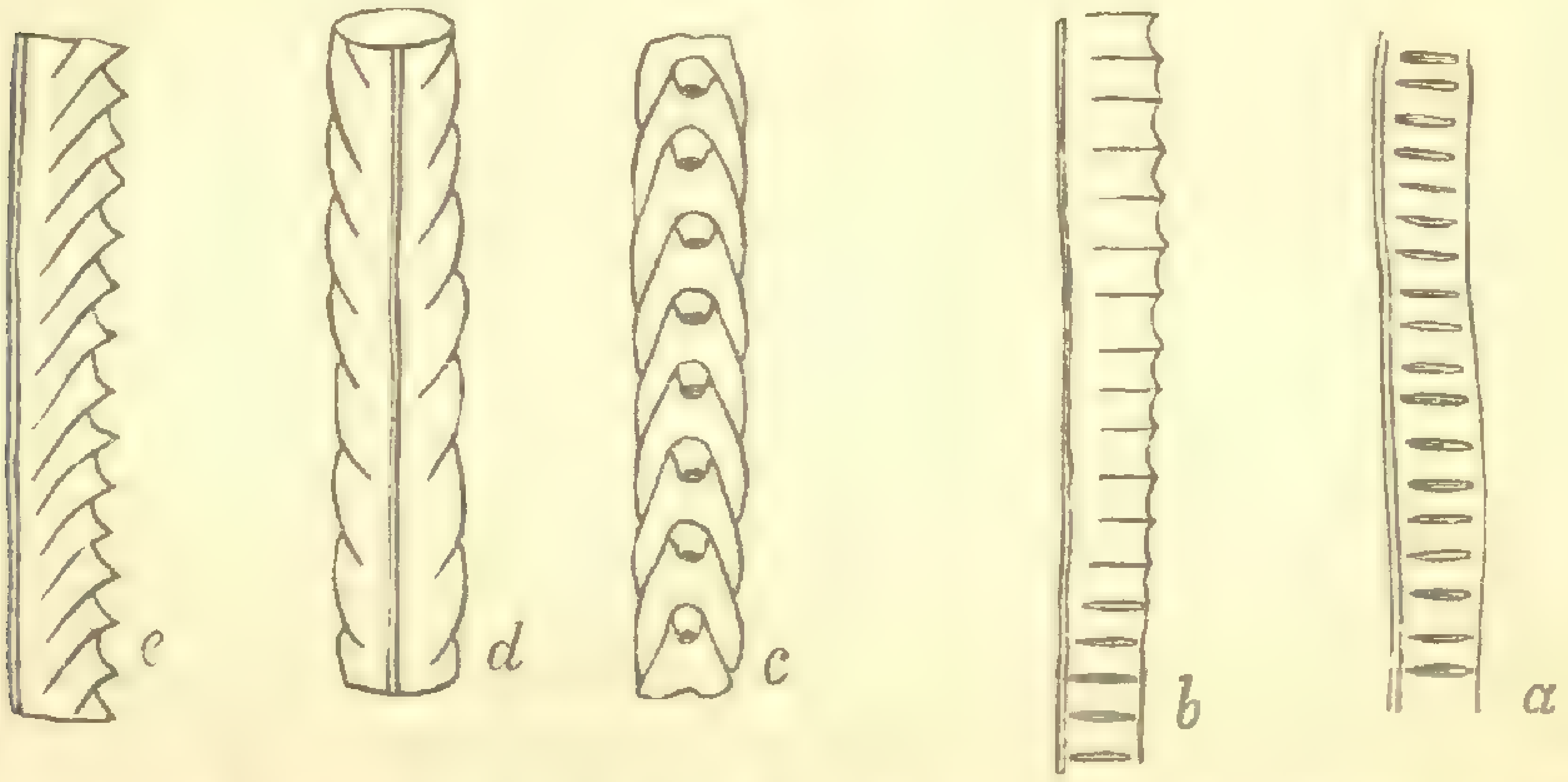
lariform" was introduced, to indicate specimens of any Graptolite compressed in this peculiar manner. By Hall (Grapt. Quebec Group, p. 111) *G. scalaris* is looked upon as the type of a double-celled or diprionidian genus (*Climacograpsus*), of which the typical form is the well-known *Prionotus* (*Diplograpsus*) *teretiusculus* of Hisinger. This view of Hall's is adopted by Mr. W. Carruthers (Intellectual Observer, May 1867; Geol. Mag. vol. v. p. 131), who further adopts Hall's suggestion that the familiar species *C. teretiusculus*, His., sp., should be named *C. scalaris.*

As regards my own views upon this subject, I should be rather disposed to doubt that the original figure of *G. scalaris* was taken from any Graptolite at all. Admitting, however, that it is a Graptolite, it is quite certain that it is impossible at the present day to decide what species it was originally meant for. I am also perfectly satisfied that it is wholly impossible, as things stand, to determine whether *G. scalaris* was intended for a monoprionidian or a diprionidian form; and no grounds can be found for the substitution of *scalaris* for *teretiusculus*, unless it can be demonstrated that the original *G. scalaris* was a bicellular form. The promoters of this substitution appear to have proceeded upon the entirely erroneous belief that unicellular Graptolites do not exhibit "scalariform" views. On the contrary, numerous instances occur in which monoprionidian Graptolites exhibit "scalariform" impressions which are absolutely undistinguishable from those impressions of any *Climacograpsus* in which no more than the apertures of a single row of cellules is exhibited. This is shown most satisfactorily by the occurrence of specimens of monoprionidian Graptolites which exhibit their ordinary characters over part of their course, but are then twisted so as to exhibit a "scalariform" view. It is also most satisfactorily proved by the occurrence of numerous scalariform impressions in rocks (such as the Coniston Grits of the north of England) in which the most careful search has hitherto failed to reveal a single double-celled Graptolite. I subjoin a cut (fig. 4) showing the phenomena above mentioned, as they occur in *G. colonus*, Barr., and *G. priodon*, Bronn—all the specimens figured having been obtained from deposits which have hitherto yielded no examples of either *Diplograpsus* or *Climacograpsus.*

If, then, the original *G. scalaris*, Linn., be a Graptolite, it is, to say the least of it, quite as likely to be the scalariform impression of a monoprionidian species as of a double-celled form. I am, therefore, decidedly of the opinion that there are no grounds for accepting the change proposed by Hall and followed by Carruthers—a change which would substitute for

a well recognized and long current form an altogether dubious and undeterminable species.

Fig. 4.



a. Scalariform impression of *G. colonus*, Barr., from the Coniston Grits near Sedbergh. *b.* Another specimen of the same, from the same locality, in which the frond is slightly twisted, so as to yield a completely scalariform impression in its lower portion and a semiscalariform view in its upper portion. *c.* Scalariform view of a fragment of *G. priodon*, Bronn, preserved in relief, from the Coniston Flags of Broughton Moor. *d.* Back view of the frond of *G. priodon*, Bronn, showing the solid axis and cell-partitions; from a specimen from the base of the Coniston Flags, west side of Long Sleddale. *e.* Ordinary lateral view of a fragment of *G. colonus*, Barr., showing the cell-denticles; from the Coniston Grits near Sedbergh. All considerably enlarged.

Loc. Skiddaw Slates (upper beds): Thornship Beck, near Shap; Ellergill Beck, near Milburn. *Lower Llandeilo*: Tyobry and other localities in Wales. *Upper Llandeilo*: everywhere in the Anthracitic Shales (Moffat Shales) of the south of Scotland, and in numerous localities in North and South Wales and in Ireland. *Caradoc*: common in the Mudstones of the Coniston series of the north of England. *Lower Llandovery*: Haverfordwest (collected by Prof. Harkness).

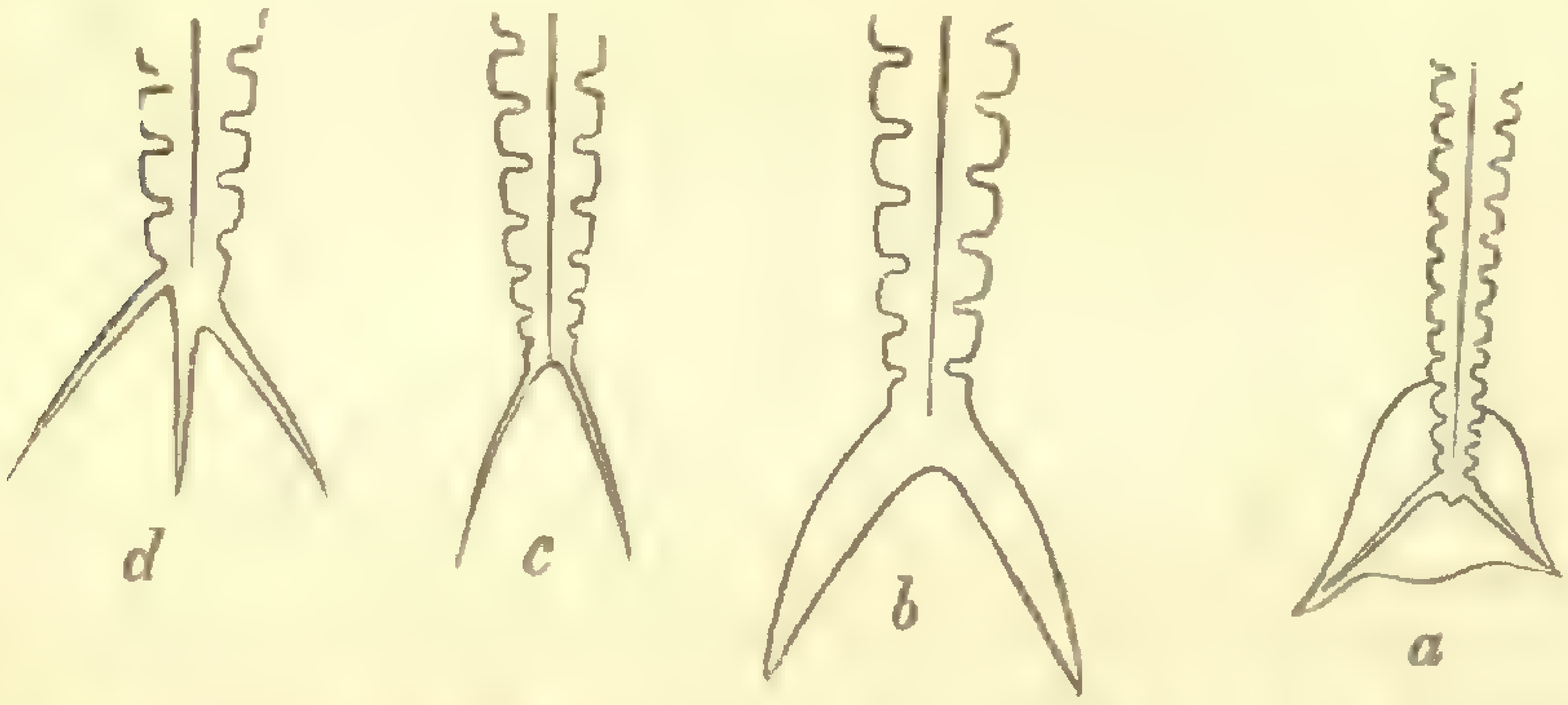
Climacograpsus bicornis, Hall.

Graptolithus bicornis, Hall, Pal. New York, vol. i. p. 268, pl. 73. figs. 2 *a–s*.
Diplograpsus tricornis, Carruthers, Ann. & Mag. Nat. Hist. Jan. 1859.

The frond in this species is diprionidian, from half an inch to two inches in length, averaging about one inch, having a breadth of about $\frac{1}{25}$ of an inch at the base, and widening out gradually till a width of more than a line may be attained. A central solid axis is present; but this does not appear to be ever produced, either proximally or distally, beyond the frond to any thing like the extent observable in *C. teretiusculus*. As regards the characters of the *base*, four distinct forms may be distinguished, though it is not clear whether these should be

regarded as genuine varieties or as being dependent upon age or development.

Fig. 5.



a. Base of *C. bicornis,* after Hall, showing a basal disk or bulb; magnified two diameters. *b.* Base of the same, showing an imperfect basal crescentic disk; enlarged, from a specimen from the Llandeilo Shales of Glenkiln Burn, Dumfriesshire. *c.* Base of the ordinary form of *C. bicornis* in Dumfriesshire, without a central radicle; enlarged. *d.* Base of the same, after Hall, showing the lateral spines flanking a central radicle (=*Diplograpsus tricornis,* Carr. ?).

In the first of these (fig. 5 *c*), which may be regarded as the typical form of the species, the base is simply provided with two curved spines or mucronate processes, which diverge from the lateral angles of the base and enclose an angle of from 40° to about 140°. As a rule, these basal processes form strong arcuate cornua; but they are not unfrequently of the nature of slender spines, and are then usually straight or only slightly curved. In any case they seldom attain a length of more than a line.

In the second form (=*Diplograpsus tricornis,* Carr. ?), in addition to the two lateral spines, there is a median process or "radicle" (fig. 5 *d*), which varies in length from a mere tubercle to half a line or more.

In the third form (fig. 5 *b*) there is developed round the lateral processes a corneous disk or bulb, of a crescentic shape, each horn of the crescent sometimes attaining, in large specimens, a length of nearly three lines. This rare and singular variety occurs not very uncommonly in a band of highly anthracitic shale in Glenkiln Burn, Dumfriesshire.

In the fourth variety (fig. 5 *a*), which was described by Hall, the basal disk is very much more extensively developed, losing its crescentic form, and extending both completely between the basal spines and also up to the level of the third or fourth cell-aperture on each side.

The frond itself of *C. bicornis* differs in no important parti-

cular from that of *C. teretiusculus*, fragments of the two species being, in the absence of the base, almost if not quite undistinguishable one from another. As in *C. teretiusculus*, the appearances exhibited vary with the particular aspect of the frond which may be presented to view. The two chief phases in which the cell-apertures present themselves are either as elliptical or lunate openings running transversely across the frond, or as lateral notches directed at right angles to the axis or having a slight downward inclination.

From the ordinary form of *C. teretiusculus* (figs. 1 *a*, 2 *a*) the present species is distinguished by its being constructed upon a scale altogether rather smaller, by its not being reduced to an acute point at the base, by its attaining its full width more gradually, and by the characters of the base itself. From that form of *C. teretiusculus* (fig. 2 *b*) in which three basal spines are present *C. bicornis* is separated by the much greater length and slenderness of the lateral processes in the former, and by the much greater development of the median spine or "radicle." In *C. bicornis*, on the other hand, the lateral spines are much shorter, stronger, and thicker, and the median process, when present at all, is very seldom so long as the lateral processes. From *C. antennarius*, Hall (fig. 6), *C. bicornis* is easily distinguished by its wanting the long setiform lateral processes at the base, and the peculiar squareness of build and uniformity of breadth which characterize the former. From *C. tuberculatus*, Nich., in which the characters of the base are somewhat the same, *C. bicornis* is separated by the absence of the tubercles which occur on the sides of the frond of the former. The spines, too, in *C. tuberculatus* are much thicker and stronger, and are nearly or quite rectangular to the axis of the frond, whilst there is always a blunt central radicle.

The presence of a basal disk or cup in some forms of the species is a remarkable fact, since there can be little hesitation in comparing this to the corneous disk of some of the *Dichograpsi* and *Tetragrapsi*.

Loc. Skiddaw Slates (upper beds): Thornship Beck, near Shap. *Lower Llandeilo*: Penmorfa &c. *Upper Llandeilo*: Anthracitic Shales of Dobb's Linn, Hart Fell, and Glenkiln Burn in Dumfriesshire.

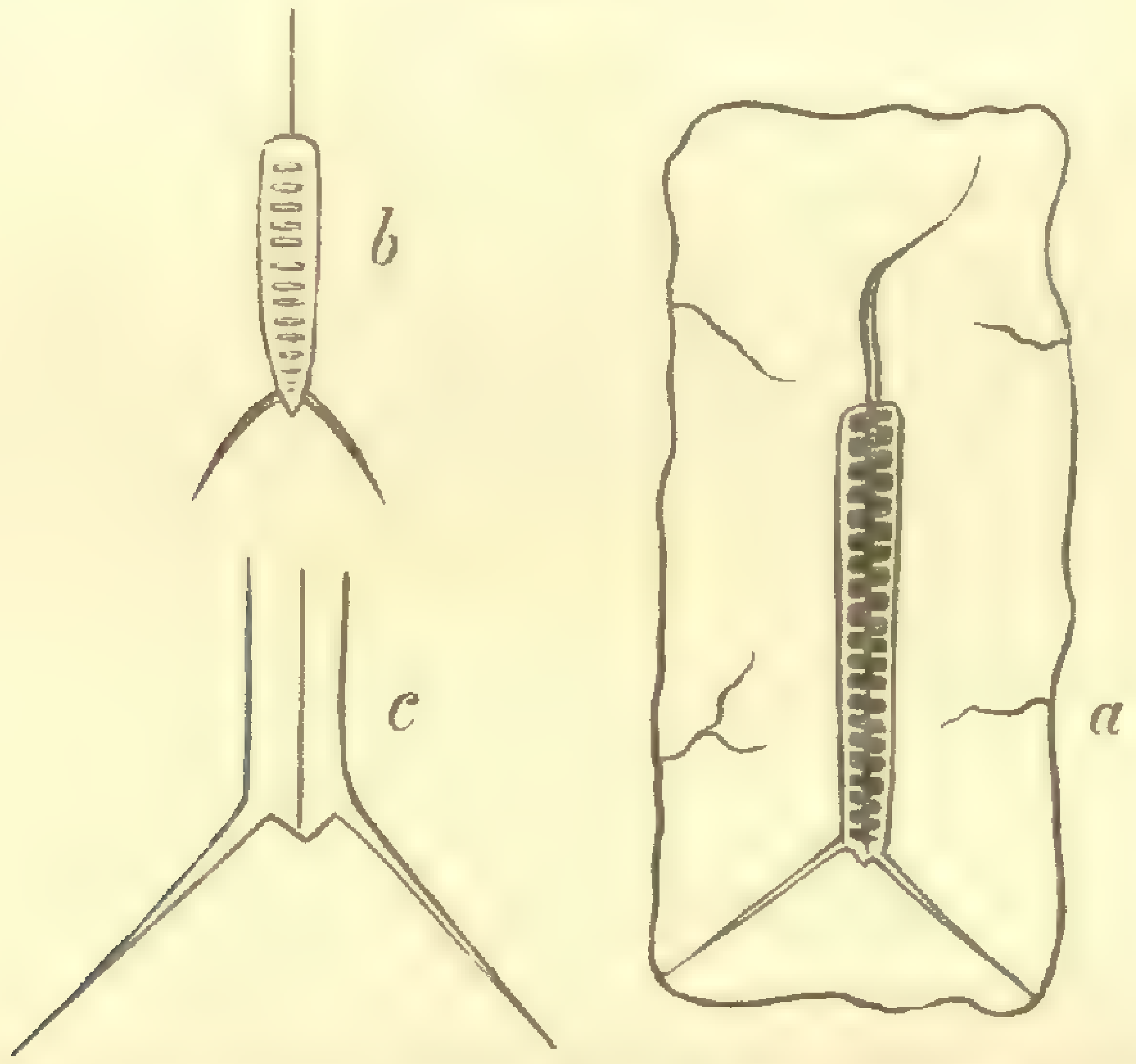
Climacograpsus antennarius, Hall.

Diplograpsus antennarius, Nicholson, Quart. Journ. Geol. Soc. vol. xxiv. p. 139.

This beautiful species has been fully described by Hall (Grapt. Quebec Group, p. 112, pl. 12. figs. 11–13), and was

first described by myself from British specimens which I obtained from the Skiddaw Slates, our British equivalent of the Quebec group of Canada. I subjoin figures of the species; but it will be unnecessary to give any detailed description, more especially as all extant British examples are in a state of preservation which does not admit of the determination of minute points of structure.

Fig. 6.



a. Climacograpsus antennarius, after Hall, showing the cell-apertures; from the Quebec group. *b.* Small specimen of the same, from the Skiddaw Slates; nat. size. *c.* Base of another specimen from the Skiddaw Slates, with unusually long basal spines; enlarged.

The essential characteristic by which *C. antennarius* is distinguished from its relatives *C. teretiusculus* and *C. bicornis* consists in the presence of three basal processes (fig. 6), of which the two lateral ones are extremely long, straight or slightly curved, whilst the central one is in the form of a minute obtusely triangular "radicle." The radicle is always extremely short, in fact, a mere tubercle; but the axis is always prolonged beyond the distal end of the frond for a greater or less distance. The frond, instead of being cylindrical, as in *C. teretiusculus* and *C. bicornis*, gives decided evidence of having been subquadrangular; but as none of our British specimens are preserved in relief, I can only judge of this point in Hall's description by the peculiar squareness of cut which all our examples exhibit. The length of the frond varies from one-fifth of an inch to somewhat over an inch; but this does not appear to be exceeded. The cellules, according to Hall, are from twenty-four to twenty-eight in the space of

an inch, "short, nearly twice as wide as long; the cell-denticles nearly rectangular to the axis."

Loc. Skiddaw Slates (lower beds): Outerside, near Keswick.

Climacograpsus tuberculatus, Nich.

I have so recently described this species (Ann. & Mag. Nat. Hist. ser. 4. vol. iv. p. 239, pl. 11. fig. 18) that any detailed reference to it is unnecessary. It is closely allied to *C. bicornis*, but is distinguished by the following points:—1. The base is furnished with a short central radicle, and two strong, curved, lateral cornua, which always enclose an angle of nearly 180°, or, in other words, are nearly rectangular to the axis of the frond. 2. The frond is furnished on each side with a row of tubercles, which appear to spring from the lateral angles of each cell-aperture.

Loc. Upper Llandeilo: rare in the Anthracitic Shales of Dobb's Linn, near Moffat.

Climacograpsus innotatus, Nich.

This species also has been recently described by myself in the paper just referred to (*op. cit. suprà*, p. 238, pl. 11. figs. 16 & 17), and therefore requires little notice. It has recently, however, been confounded with the so-called *Climacograpsus minutus*, Carr., which is really nothing more than the immature form of *C. teretiusculus*, from which it differs in no characteristic of specific importance. *C. innotatus*, on the other hand, is at once distinguished by the possession of a short stout spine which arises from the inferior angle of each of the portions of the frond between the cell-apertures, and is directed horizontally over the mouth of the cellule immediately below. No such structure is recognizable in *C. teretiusculus* at any period of its development.

XXXVII.—*On an existing Coral closely allied to the Palæozoic Genus* Favosites; *with Remarks on the Affinities of the* Tabulata. By W. Saville Kent, F.Z.S., F.R.M.S., of the Geological Department, British Museum*.

[Plates XVII. & XVIII.]

During a pleasant fortnight spent last year in studying the fine typical collection of Madrepores contained in the Paris Museum, my attention was arrested by a worn specimen,

* A brief notice of this new form was given at the recent meeting of the British Association at Liverpool.

stowed away in a corner, as though undeserving of notice, which, on closer examination, was found to exhibit a most important and significant character.

In general external appearance this Coral bore a strong resemblance to *Alveopora fenestrata*, Dana (*Pocillopora fenestrata*, Lamk.); and on the under surface of the block which supported it faint pencil characters, implying that it belonged to that species, were just discernible. Unfortunately, no record suggestive of the locality whence this interesting specimen was obtained accompanied it, neither is any preserved in the archives of the museum; its recent character, however, is beyond doubt.

The prominent feature embodied with those of *Alveopora*, and which rendered it so strikingly distinct from any representative of that genus, lay in the presence of numerous irregularly scattered, but perfect and well-developed tabulæ or horizontal partitions. Taken altogether, these characters demonstrated it to be closely allied to the long extinct genus *Favosites—Koninckia*, of the Cretaceous epoch, forming an immediate connecting link.

Withdraw the tabulæ, and the specimen forming the subject of this paper is in no wise distinct from an ordinary *Alveopora*; it possesses the same reticulate structure of the general sclerenchyma and the same irregular trabecular septal arrangement; the individual septa, moreover, frequently coalesce as in that genus*.

In *Koninckia* we have a similar reticulate structure of the calices; but the septal system is regular, consisting of a series of six stout, short, conical, and widely separated elementary components, which never evince a tendency to coalesce. To this are added irregularly scattered tabulæ. On arriving at *Favosites* we find a septal and tabular system closely resembling what obtains in the last-named genus; but the general sclerenchyma can scarcely be called reticulate, the walls of the calices being composed of perfect laminæ, with more or less evenly disposed perforations. The close affinity of the three forms, however, is so evident that they cannot be further than generically separated.

Favositipora is the generic name I propose for the Coral I here introduce; it embodies the structural characters of the two groups of the Poritidæ and Favositidæ, hitherto considered distinct; the specific name of *Deshayesii* I bestow upon

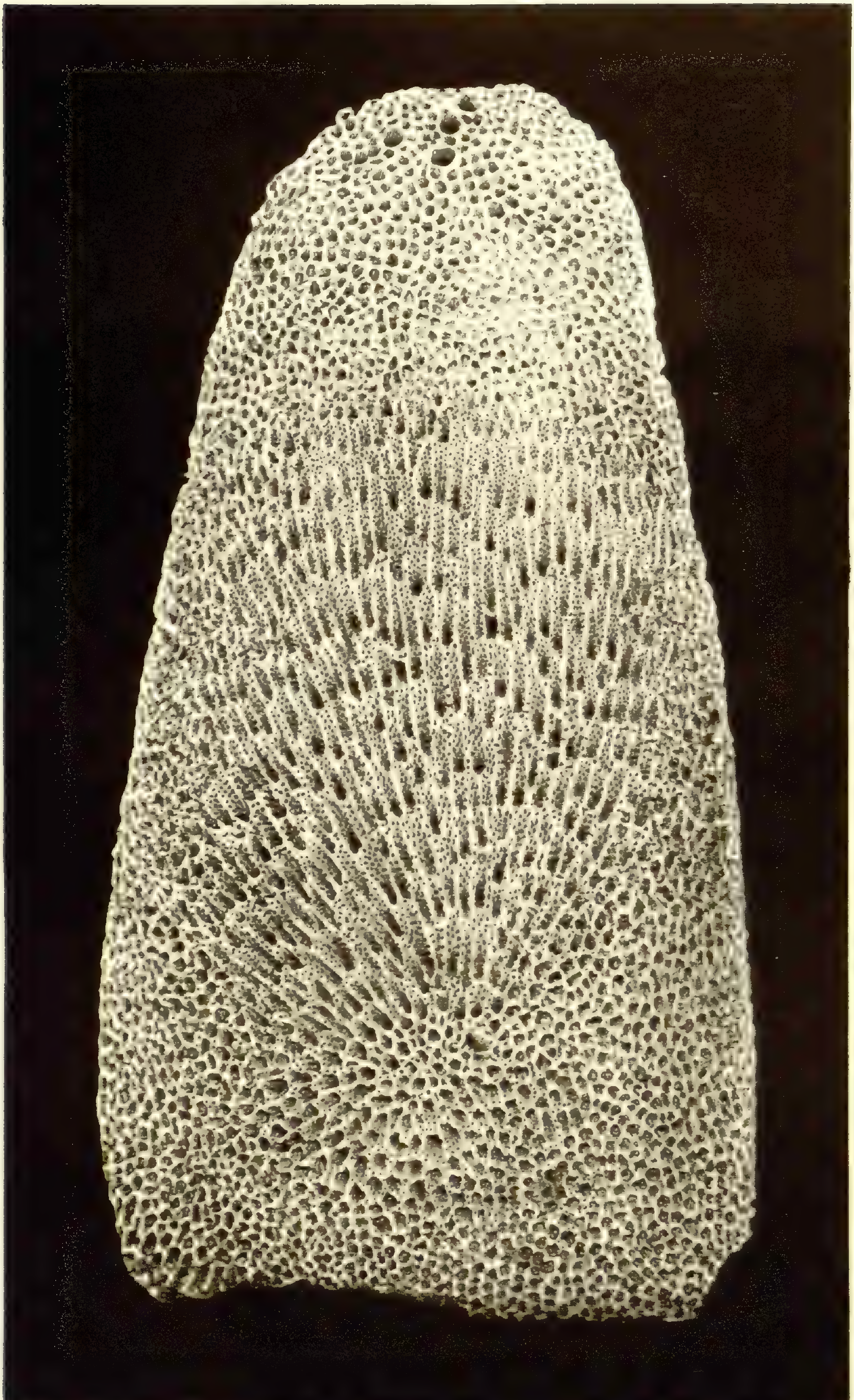
* It also very frequently happens that two opposite septa are most developed, and meet in the centre of the calyx; in this respect it shows its affinity to the genus *Madrepora*, also belonging to the Perforata, and in which this peculiarity is a dominant feature.

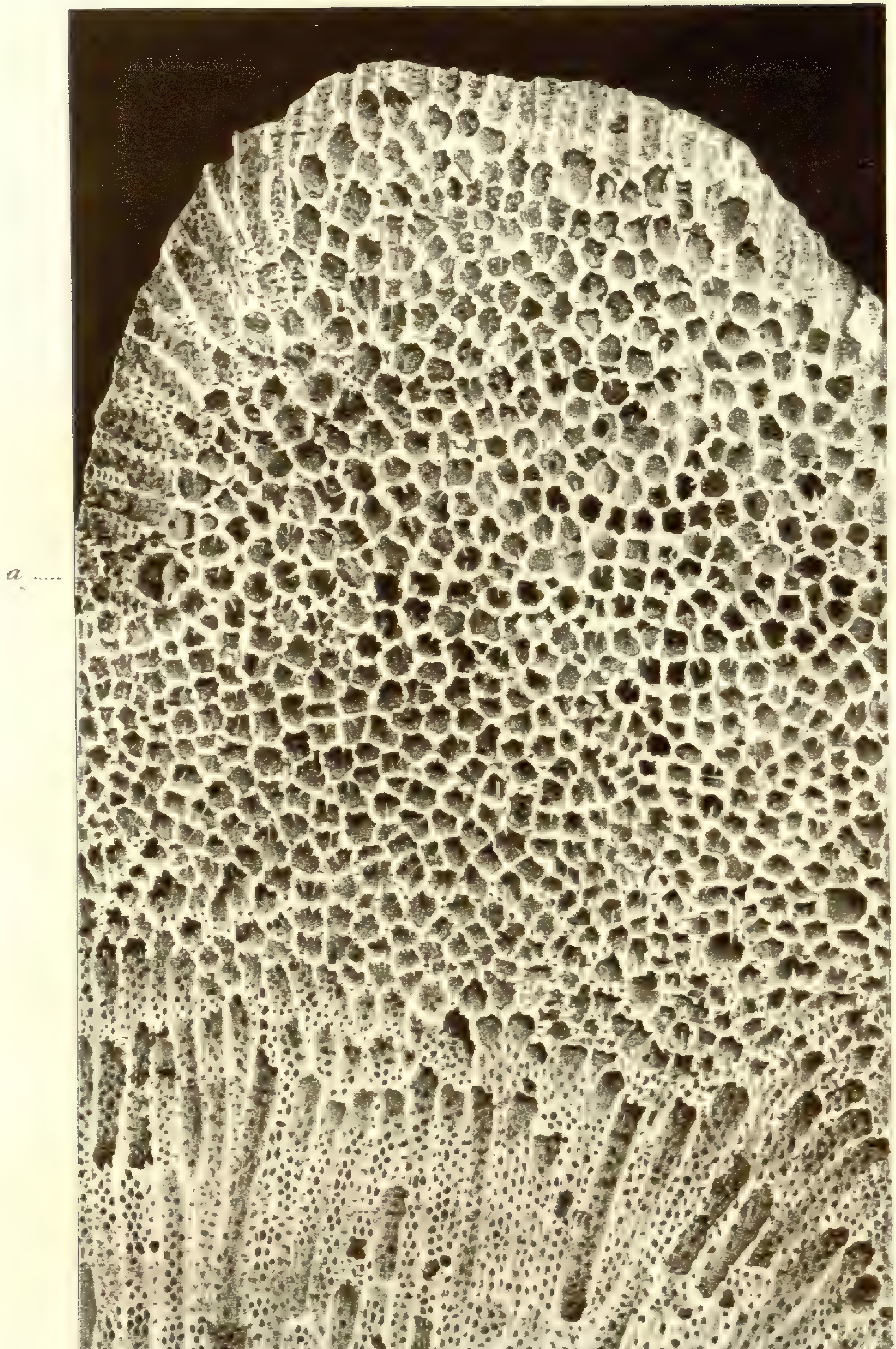
it as a slight tribute of regard for my friend M. Deshayes, the talented and energetic conservator of the Invertebrate department of the Paris Museum, to whom and to his *confrère* M. L. Rousseau, I am under the deepest obligations for the great facilities and considerable amount of personal assistance they rendered me during the fortnight I spent in familiarizing myself with the contents of their superb Museum. I can scarcely say more than that, if the establishment had been under my own immediate superintendence, I could not have studied the collection with greater advantages.

By the kind permission of Prof. Milne-Edwards, M. Potteau (the skilful photographer, and preparer of natural-history specimens, attached to the Paris Museum) has executed for me some excellent photographs of this interesting Coral, from which the plates accompanying this paper have been engraved.

Since encountering the coral just described, I have discovered, while arranging the collection of fossil corals in the British Museum, a specimen to which no record is attached, but evidently belonging to the Palæozoic series, and most probably to the North-American Devonian or Carboniferous strata, which, in the structure of its corallum, certainly cannot be made generically distinct from the existing form now introduced, and, except in the coarser character of its reticulate sclerenchyma and the larger size of its calices, would not seem even to differ specifically. This last new species I propose to distinguish by the title of *Favositipora palæozoica.*

But not only is the existing *F. Deshayesii* interesting on account of its close relationship to extinct Palæozoic forms, but its affinity to the recent genus *Alveopora*, from which, as before observed, it differs only by its possession of scattered tabulæ, is weighty evidence in controversion of the theory advocated by Professor Agassiz that all the Tabulate Corals are the skeletal productions of Hydrozoa. *Alveopora* is a well-known Actinozoon, and it is more than probable that the closely approximating *Favositipora* is referable to the same class. But one of the most cogent objections that may be brought forward in opposition to Professor Agassiz's theory is the fact that the greater number of the Tabulata possess well-developed septa. Now septa are calcifications produced between the folds of the mesenteries; and mesenteries only occur in the Actinozoa, where they assume the form of fleshy bands connecting the wall of the alimentary canal with the external wall of the animal's body. In the Hydrozoa there is no distinct alimentary canal, and consequently no mesenteries; and it must necessarily follow that no Hydrozoon could possibly produce





a

septa, and hence that no septate coral can be referred to the Hydrozoa.

The affinities of *Favositipora* with *Favosites*, on the one hand, and *Alveopora*, on the other, also demonstrate that the recognition of the Tabulata and Perforata as two widely separated sections must now cease to be defensible, the first-mentioned genus showing how completely the one group merges into the other.

I may quote this form, again, as evidence bearing out the truth of my assumption, disputed by Mr. Lankester in a previous number of this Magazine, that the Corals of the Palæozoic epoch were equally complex and highly developed with those peopling the existing seas. *Favositipora*, as already shown, is little else than a more highly differentiated or tabulate *Alveopora*. In Palæozoic times there existed a coral generically identical with it, and a number of others closely allied and possessing in a still greater degree of development this more highly differentiated character.

The two plates accompanying this paper are prepared from the original photographs executed for me in Paris, the first one representing the coral of the natural size, and Pl. XVIII. illustrating a portion of the reverse side of Pl. XVII., considerably enlarged. As an experiment, they are highly successful, and promise much for the future of photo-lithography as applied to the representation of objects of natural history; at the same time, neither the tabulate arrangement nor the essentially trabecular character of the sclerenchyma are evidenced so conspicuously as in the original photographs. In Pl. XVIII., on the left-hand side the letter *a* is placed opposite an extraordinarily large calyx (about half an inch from the margin), in which a tabula has been fractured across its centre, leaving the larger half of the calyx entirely open. Recognizing this, it will be easy to detect where the tabulæ occur or are absent in the remaining portion of the plate.

XXXVIII.—*The Geographical Distribution of the Cetacea.* By Dr. J. E. Gray, F.R.S. &c.

I have for years been collecting all the information I could find on the Cetacea, and have published the results in a series of papers in the 'Proceedings of the Zoological Society' and in the 'Annals and Magazine of Natural History,' and I have combined these, together with the materials I have been able to collect from various travellers and other scientific writers on Cetacea, in the 'Catalogue of Seals and Whales in the British

Museum,' published in 1866, in the 'Synopsis of Whales and Dolphins,' published in 1868; and since that time I have continued to take advantage of examining all the specimens that I could see and the various works of Flower in England, Eschricht, Reinhardt, Lilljeborg, and Sars in Scandinavia, Van Beneden in Belgium, Gervais in Paris, and Burmeister in Buenos Ayres.

I am quite aware that we still have but a very imperfect knowledge of these animals; but we shall soon be better informed if we go on as we have done since I first published my essay on the Cetacea in the 'Voyage of the Erebus and Terror' in 1846, where I first asserted that the whales from different localities were different species, and that there were several species found in our own seas, and thus more than doubled the number of the Cetacea hitherto recorded as inhabitants of our seas. I also came to the conclusion that the whalebone-whales that were found in different seas were distinct species. Indeed the older navigators observed that a Right Whale was never found within the tropics, and the truth of this statement has been verified by modern observers; and therefore one might almost conclude *à priori* that the Right Whales of the northern and southern seas were distinct species: the examination of the various kinds of whalebone confirmed this fact, and also proved that there were not only two kinds of whales caught for the sake of the whalebone, but several, the whalebone of each (fetching a different price in the market, and being used for very different economic purposes) affording very good characters for the distinction of these kinds, when submitted to microscopic examination. The same fact was shown to exist among the Humpbacks and Finners, as the "whale-fin" merchants, as they are called, have many species fetching very different prices and being used for very different purposes.

In the work quoted I proved, by the examination of the measurements which had been given by Sibbald, Knox, and others, when they were submitted to comparison and sketched to scale, that there were several species of Finner Whale in the European seas. Recently Sars has repeated this comparison, with the same conclusion.

I have prepared the accompanying list of the species of Cetacea, arranged geographically, believing that, imperfect as I know it to be, it will be one of the best means of procuring more materials for increasing our knowledge of these animals, and thus enabling us to obtain a better account of their distribution. The species are named in the 'Synopsis of Whales and Dolphins' or in the 'Catalogue of Seals and Whales.'

The names in italics belong to very imperfectly known species, at least to those of which no remains are known to exist in museums.

I have divided them into three great sections:—

1. The species found in the northern seas, which I have subdivided into those living (1) in the North Atlantic (which I consider as including the North and Arctic Seas and the Mediterranean), and (2) the North Pacific Ocean.

2. The species which are found inhabiting the tropics:—first, of the Atlantic; secondly, the Indian Ocean and Red Sea; and thirdly, the tropical regions of the Pacific Ocean.

3. The species found in the southern seas, which are subdivided into those of Australia, South Africa, and South America, because most of the specimens in the Museum have been obtained from specimens thrown on the shores of these countries.

In all these sections I have regarded the species found in the rivers as inhabiting the regions in which the mouths of the rivers are situated, as many species ascend the mouths of the rivers at least as far as the water is brackish. I have also included the few species which are truly fluviatile, as those of the Upper Amazons and Indian rivers, under the same rule.

There are very few species which are found common to more than one of these divisions; and I believe, when the species have been more carefully examined, their number will be less than it now appears to be. The most striking case of this kind occurs in the Sperm Whale. This species is essentially a native of the tropical seas, and appears to be equally common to the tropical parts of the Atlantic, Indian, and Pacific Oceans; but it often wanders into the more temperate seas, and is sometimes found as far north as the Orkneys; but then it is only found in the Gulf-stream; and I believe it is found equally in the colder parts of the Southern Ocean. Maury observes that it frequently rounds Cape Horn; but it has not been known to round the Cape of Good Hope, although the former is much further south than the latter.

The second instance is *Neomeris phocænoides*, which is said to inhabit the Indian Ocean, having been obtained in the Bay of Bengal and Malabar, the Cape of Good Hope and Japan; but I suspect that, when the animals and their skeletons are more carefully examined, they may be found to be distinct species. The specimens from each of these localities are black, so that colour does not help to distinguish them.

The Cape Dolphin, *Delphinus longirostris*, is said to have the same distribution: this is also a black species. The common Dolphin is said to have even a wider distribution, from the North Sea to Australia and various parts of the Pacific; but although the skulls from these localities agree

in the form and length of the beak compared with the brain-cavity, in the palate being grooved on each side, in the number and size of the teeth, and in their disposition on the border of the maxilla (that is to say, having the same number in the space of an inch), it is now known that these animals from the North Sea, from the South Atlantic, and from Australia are very differently coloured, and, further, that there are two species, *Delphinus Moorei* and *D. Walkeri*, very differently coloured, in the South Atlantic, and both are very unlike *D. fulvifasciatus* of Van Diemen's Land; and I have reason to believe that there are several more species from different localities that cannot be distinguished by their skulls.

The species of these animals until very recently we have believed could be best distinguished by their skulls; but the above facts and other similar ones that have come to my knowledge confirm me in the belief that there are many species which have exactly the same skulls, or at least so similar that it is not easy to express their differences in words, that are to be distinguished by their external colouring and also probably by peculiarities in other parts of their skeleton, and most likely each having a peculiar geographical distribution. On the other hand, it is to be remarked that there do exist species in very different parts of the world that have exactly the same coloration—as *Globiocephalus svineval* of the North Sea and *G. Edwardsii* of the Cape of Good Hope, which are believed to be very distinct species.

Another difficulty occurs in the same name being given to very different kinds of Cetacea by the whalers. Thus the name of "Blackfish" is applied to *Pseudorca meridionalis* in Van Diemen's Land and to *Globiocephalus macrorhynchus* in the South Seas. Probably those from the Indian Ocean and Kerguelen's Land are distinct species.

Two or three northern species of *Orca* are black, marked with white in the same manner; and I have reason to believe that some of the other species are similarly marked: so that the colouring of these animals becomes almost a generic character, which explains their having been confounded as one species. In the same way, entire blackness seems to be characteristic of the genera *Pseudorca*, *Neomeris*, and some other Cetacea.

There is no reason why there should not be as many kinds of whales in the Southern Ocean as in the northern seas, especially when we consider how much more extensive it is compared with the land than in the northern regions. I strongly suspect that the reason the number of species appears to be less arises from their having been only lately studied, and consequently the very imperfect knowledge we have of the inhabitants of that region.

NORTHERN AND TEMPERATE SEAS.

NORTH ATLANTIC.

BALÆNIDÆ.

Balæna mysticetus.
var. *angulata.*
var. *mediterranea.* Mediter.
var. *islandica.* Iceland.
B. britannica. Lyme Regis.
Balæna biscayensis. Biscay.
Eubalæna cisarctica.
Hunterius Swedenborgii.

AGAPHELIDÆ.

Agaphelus gibbosus. N. America.

MEGAPTERIDÆ.

Megaptera longimana.
Eschrichtius robustus.

PHYSALIDÆ.

Benedenia Knoxii.
Physalus antiquorum.
P. Duguidii.
Cuvierius Sibbaldii.
Rudolphius laticeps.
Sibbaldius borealis.
Sibbaldius tuberosus.

BALÆNOPTERIDÆ.

Balænoptera rostrata.

CATODONTIDÆ.

Catodon macrocephalus.

PHYSETERIDÆ.

Physeter tursio.

DELPHINIDÆ.

Steno coronatus. Spitzbergen.
Steno rostratus.
Delphinus delphis.
D. Janira. Newfoundland.
D. Tethyos. Mediterranean.
D. punctatus.
Clymenia Euphrosyne.
Tursio frenatus.
T. truncatus.
Electra acuta.
Lagenorhynchus albirostris.
Leucopleurus arcticus.
Phocæna communis.
P. brachyrhyncha.
Orca gladiator.
O. stenorhyncha.
O. latirostris.

NORTH PACIFIC.

BALÆNIDÆ.

Balæna abugulich. } Aleutian Islands.
B. mangidach. } Aleutian Islands.
B. agamachtschich. } Aleutian Islands.
Balæna mysticetus? Behring's Strait.
B. callamach.
Eubalæna Sieboldii, Japan.

AGAPHELIDÆ.

Rhachianectes glaucus. S. Francisco.

MEGAPTERIDÆ.

Megaptera kuzira. Japan, Amur.
M. versabilis.

PHYSALIDÆ.

Physalus iwasi. Japan.
Sibbaldius tectirostris.
S. sulphureus.

BALÆNOPTERIDÆ.

Balænoptera telifera.

CATODONTIDÆ.

Catodon macrocephalus.

DELPHINIDÆ.

Delphinus Styx.
Electra thicolea.
Delphinapterus borealis.
Neomeris phocænoides. Japan.
Phocæna vomerina.
Orca atra.
O. pacifica.
O. rectipinna.

NORTH ATLANTIC.

GLOBIOCEPHALIDÆ.

Globiocephalus svineval.
Sphærocephalus incrassatus.

BELUGIDÆ.

Grampus Cuvieri.
G. Rissoanus.
Beluga catodon.
Monodon monoceros.

HYPEROODONTIDÆ.

Hyperoodon butzkopf.
H. semijunctus.
Lagenocetus latifrons.

EPIODONTIDÆ.

Epiodon Desmarestii.

ZIPHIIDÆ.

Ziphius Sowerbiensis.

NORTH PACIFIC.

GLOBIOCEPHALIDÆ.

Globiocephalus Sieboldii. Japan.
G. chinensis.
G. Scammonii.

BELUGIDÆ.

Grampus sakamata. Japan.

II. TROPICAL SEAS.

ATLANTIC.

MEGAPTERIDÆ.

Megaptera americana. Bermuda.

PHYSALIDÆ.

Physalus brasiliensis. Bahia.
P. fasciatus. Peru.

CATODONTIDÆ.

Catodon macrocephalus.

INIIDÆ.

Inia Geoffroyi. Upper Amazons.

DELPHINIDÆ.

Steno tucuxi. } Upper Amazons.
S. fluviatilis. }
S. pallidus. }
S.? fuscus. Cuba.
Delphinus Janira. Jamaica.
Clymenia microps. Brazil.
C. Styx. West Africa.
Sotalia guianensis. British Guiana.

GLOBIOCEPHALIDÆ.

Globiocephalus guadalupensis.

PACIFIC.

PHYSALIDÆ.

Sibbaldius Schlegelii. Java.

BALÆNOPTERIDÆ.

Swinhoia chinensis. Formosa.

CATODONTIDÆ.

Catodon macrocephalus.

DELPHINIDÆ.

Delphinus Forsteri.
Delphinapterus Peronii. N. Guinea.

INDIAN OCEAN.

PHYSALIDÆ.

Physalus indicus.

CATODONTIDÆ.

Catodon macrocephalus.

PHYSETERIDÆ.

Kogia simus.

PLATANISTIDÆ. Fluviatile.

Platanista gangetica. Ganges.
P. Indi. Indus.

DELPHINIDÆ.

Steno Macleayensis.
S. roseoventris. Malacca.
S. frontatus. Bengal.
S. brevimanus.
S. attenuatus.
Steno chinensis.
S. lentiginosus.
Delphinus longirostris.
D. pomeegra.
D. pernigra.
Tursio Eurynome.
Orca brevirostris.
O. capensis. Seychelles.
Electra fusiformis.
Neomeris phocænoides.
Clymenia gadamu.
Orcaella brevirostris.

GLOBIOCEPHALIDÆ.

Globiocephalus indicus.

ZIPHIIDÆ.

Dioplodon seychellensis.

III. SOUTH OR SOUTHERN TEMPERATE SEAS.

AUSTRALASIA.

BALÆNIDÆ.

Neobalæna marginata. West Australia, New Zealand.
Caperea antipodarum. New Zealand.
Macleayius australiensis. Australia.

MEGAPTERIDÆ.

Megaptera novæ-zelandiæ. New Zealand.
Hunchback. Australia Felix.

PHYSALIDÆ.

Physalus antarcticus. New Zealand.

CATODONTIDÆ.

Catodon macrocephalus (straggler).
C. australis (same as preceding).
Meganeuron Krefftii.

PHYSETERIDÆ.

Kogia Macleayii.
Euphysetes Grayii.

DELPHINIDÆ.

Delphinus novæ-zelandiæ.
D. fulvifasciatus. Van Diemen's Ld.
Tursio catalania. N.W. Australia.
Orca gladiator. Australia.
Pseudorca meridionalis.

SOUTH AMERICA.

MEGAPTERIDÆ.

Megaptera Burmeisteri.
Hunchback. Terra del Fuego.

PHYSALIDÆ.

Physalus australis? Falkland Is.
P. patachonicus. River Plate.
Sibbaldius? antarcticus. Buenos Ayres.

CATODONTIDÆ.

Catodon macrocephalus.

PONTOPORIADÆ.

Pontoporia Blainvillei.

DELPHINIDÆ.

Steno compressus.
S. attenuatus.
Delphinus microps.
D. Moorei.
D. albimanus.
Clymenia Alope. Cape Horn.
C. obscura.
Eutropia Dickiei. Chili.
Electra clancula.
Tursio symodice.
Phocæna australis. Patagonia.
Acanthodelphis spinipennis.
Lagenorhynchus cæruleo-albus.
L. breviceps.

AUSTRALASIA.

GLOBIOCEPHALIDÆ.

Globiocephalus macrorhynchus.

BELUGIDÆ.

Beluga Kingii.

ZIPHIIDÆ.

Berardius Arnuxii. New Zealand.
Dioplodon seychellensis.

SOUTH AMERICA.

Delphinapterus Peronii.
Orca magellanica. Patagonia.
O. pacifica. Chili.

GLOBIOCEPHALIDÆ.

Globiocephalus macrorhynchus.
G. Grayii.

EPIODONTIDÆ.

Epiodon cryptodon. Buenos Ayres.

SOUTH AFRICA.

BALÆNIDÆ.

Eubalæna australis. Cape of Good Hope.
Hunterius Temminckii. C. G. H.

MEGAPTERIDÆ.

Poescopia Lalandii. C. G. H.

BALÆNOPTERIDÆ.

Balænoptera Smithii. C. G. H.

CATODONTIDÆ.

Catodon macrocephalus.

PHYSETERIDÆ.

Kogia breviceps.

DELPHINIDÆ.

Steno capensis.
Delphinus Doris. C. G. H.
D. longirostris. C. G. H.
Delphinus sao.
D. Moorei.
D. Walkeri.
Eutropia Heavisidii. C. G. H.
Clymenia obscura.
C. similis.
Orca gladiator australis.
O. capensis.
Neomeris phocænoides. C. G. H.

GLOBIOCEPHALIDÆ.

Globiocephalus Edwardsii.

BELUGIDÆ.

Grampus Richardsonii.

EPIODONTIDÆ.

Petrorhynchus capensis.
P. indicus.

ZIPHIIDÆ.

Dolichodon Layardii.

XXXIX.—*Synonymical Notes on North-American Coleoptera.* By JOHN L. LECONTE, M.D., Philadelphia.

DURING very brief visits to London and Paris in the autumn of 1869, I examined the types of many species of Coleoptera, chiefly from the United States, which were previously unknown to me, or which for various reasons could only be doubtfully referred to forms known under other names. It was my intention to make renewed studies of some of the latter, with the object of determining those that still remained uncertain; but by circumstances beyond my control I have been prevented from again visiting the collections in which the types are preserved.

I have therefore thought that the interests of science would be better served by publishing without further delay the syn-

onyms of which I have no doubt, with notes which will enable some of the others to be identified, leaving those that still remain uncertain for future investigation.

The want of all books of reference prevents me from adding the bibliography of the species mentioned; but the catalogue of Harold and Gemminger will enable the student to supply this defect in these notes with but little inconvenience.

It will be observed with regret that the hastily written and very imperfect descriptions of species from British Columbia published by Mr. Walker* have in reality added nothing to our knowledge of the fauna of that region. Nearly all of his species proved on inspection to be well known to American entomologists under other names; and in several instances, as will be seen below, the irrecognizable descriptions have been made still more obscure by the reference of the species to genera quite different from those to which they really belong. This contribution to the entomology of British Columbia seems also to have been written without reference to the previously existing literature, by no means insignificant in quantity or meagre in details, in which the species found both north and south of the region in question are described.

It is my privilege in these notes to restore the names given by Mr. Kirby† to several not uncommon species. The progress of the science, in establishing genera upon minute differential characters, has rendered some of his very definite descriptions of somewhat doubtful application; but, reference being had to the original objects, no one will fail to recognize the fidelity with which in a few words he has presented their most prominent diagnostics.

My most sincere thanks are due to Mr. C. O. Waterhouse for the kindness with which, at much sacrifice of time, he sought for me, in the vast collections of the British Museum, the specimens which I wished to see; and also to M. A. Sallé, whose friendship I had experienced on former occasions, for the valuable aid he gave me in obtaining access to the collections in Paris.

I. Types of Mr. Kirby (British Museum).

1. *Cicindela obliquata*, Kirby, seems to be a peculiar race of **vulgaris**, Say (*obliquata*, Dej.); the markings are a little broader than usual, and the median band is dilated on the margin of the elytra. I do not think these differences specific,

* 'The Naturalist in British Columbia,' by John Keast Lord: London, 1866, vol. ii. Appendix.

† Fauna Boreali-Americana, vol. iv.

as the range of *C. vulgaris* is very extensive, and it is subject to much variation. I have previously viewed this race, unknown to me in nature, as a doubtful synonym of *C. generosa*, Dej., a very different insect, which is itself a race of *C.* **formosa**, Say; afterwards, believing it to be distinct, I proposed for it the name of *C. Kirbyi* (Proc. Acad. Nat. Sc. Philadelphia, 1866).

2. *Elaphrus* **Clairvillei**, Kirby. According to the type, this is the species afterwards described as *E. politus*, Lec.

3. *E.* **intermedius**, Kirby, is not the large Kansas species, with a broad and strongly constricted prothorax, which I had determined as such, but a smaller one, of the size of *E.* **ruscarius**, Say, from which it differs by the prothoracic and mesothoracic pleuræ being more finely and densely punctured. It seems to be one of the races which, in the 'List of Coleoptera of North America,' I have grouped under *E. californicus*, Mann., over which name it has priority.

4. *E.* **obscurior**, Kirby. The only specimen is in very bad condition; it resembles the Alaskan *E.* **obliteratus**, Mann., but is much smaller. The elytra are very feebly and sparsely punctured, the ocellate impressions are shallow, and there are two or three polished subsutural spots*.

5. *Anchomenus angusticollis*, Kirby; afterwards described as *Platynus* **stygicus**, Lec. This species has no resemblance to the European *P.* **angusticollis**; and it was probably from some confusion of labels that it was so referred by Mr. Kirby.

6. *Agonum seminitidum*, Kirby, =*A.* **cupreum**, Dej., =*A. chalceum*, Lec. A common species in the Lake-Superior region.

7. *A.* **affine**, Kirby. A rather stout and convex species, probably different from any in my collection.

8. *A.* **simile**, Kirby. A small, narrow, slightly bronzed species, with the legs and antennæ black. The Alaskan *A.* **fragile**, Mann., which I saw in Baron Chaudoir's collection, closely resembles it, and probably belongs to the same species.

9. *A. erythropum*, Kirby. As far as can be determined from the specimen, which is in very bad condition, this is *Platynus* **subcordatus**, Lec., a very abundant species in the regions beyond Lake Superior.

10. *Argutor bicolor*, Kirby. The head is wanting in the specimen; but, from the form of the prothorax and the distinct scutellar striæ, it belongs to the *Argutor* division of *Pterostichus*, and does not differ from *P.* **patruelis** (Dej.).

11. *A.* **brevicornis**, Kirby, is a small *Pterostichus* of the

* I have seen in the same collection a specimen of *E.* **lapponicus**, labelled "Arctic America," which is quite undistinguishable from European examples.

Cryobius group. The prothorax is rather broad, narrowed behind; the sides are feebly sinuate near the basal angles; the basal impressions are single, narrow, and distant from the angles; the elytral striæ are very distinctly punctured. It seems by these characters to agree with an Alaskan form in my collection which I have received under the names *C. fastidiosus*, Mann., and *C. frigidus*, Esch. Another type of the former in my possession more nearly resembles the next.

12. *A. mandibularis*, Kirby, is also a *Cryobius*, of a distinctly bronzed colour; the prothorax is not much narrowed behind, and the sides are distinctly sinuate near the basal angles; the basal impressions are deep, and there is a very small external one at the angles. In these respects it corresponds with *Feronia* **riparia**, Dej., a common Alaskan species.

The North-American species of the *Cryobius* group need a thorough revision: the number described has become quite large; and, so far as I can judge by the typical specimens from Alaska, which I have received by the kindness of Baron Chaudoir, Count Motschulsky, and Prof. Macklin, they are separated in some instances by almost imperceptible characters. I have obtained specimens from the summits of the White Mountains of New Hampshire, which scarcely differ from others collected in the Hudson-Bay territory and in Alaska: it is therefore probable that some of the forms have a wide distribution, and that, by comparison of series from distant localities, the limits of variation will be ascertained, and the number of opinionative species reduced.

13. *Amara* **discors**, Kirby, =*gibba*, Lec.

14. *A.* **lævipennis**, Kirby, is a very distinct species of the *Celia* group, remarkable for its small size, narrow form, and highly polished surface.

15. *Chlænius* **quadricollis**, Kirby, =*brevilabris*, Lec.

16. *C. impunctifrons*, Kirby (*nec* Say), = **pennsylvanicus**, Say.

17. *C.* **cordicollis**, Kirby, is the abundant northern species formerly extensively distributed in America as *C. chlorophanus*, Dej., which is really a synonym of *C.* **solitarius**, Say, as has been already observed by Baron Chaudoir.

18. *Harpalus* **laticollis**, Kirby. This is not *Anisodactylus* **nigerrimus** (Dej.), as I have incorrectly placed it in the 'List of North-American Coleoptera,' but *A. Harrisii*, Lec., which differs from *A. nigerrimus* by having the sides of the prothorax feebly but distinctly flattened near the base.

19. *H.* **basilaris**, Kirby. As I indicated (Proc. Acad. Nat. Sc. Philad. 1865), this is the same as *H. obesulus*, Lec. It is not uncommon from Lake Winnipeg to Oregon.

20. *H.* **ochropus**, Kirby, seems to be the species afterwards described as *H. fulvilabris*, Mann.

21. *Peryphus* **concolor**, Kirby, is a very distinct and well-defined species; the prothorax is quadrate, slightly narrowed behind; the basal impressions are distinctly double; the elytral striæ are strongly punctured and nearly effaced towards the tip.

22. *P. sordidus*, Kirby, is merely an immature specimen of *P.* **bimaculatus**, Kirby.

23. *Laccophilus biguttatus*, Kirby, is an immature specimen of our common small species, *L.* **proximus**, Say, =*americanus*, Aubé.

24. *Necrophorus* **obscurus**, Kirby. This is the species, allied to *N.* **marginatus**, which I erroneously determined as *N. Melsheimeri*, Kirby.

25. *N. Melsheimeri*, Kirby, =**Sayi**, Laporte, =*lunatus*, Lec.

26. *N.* **hebes**, Kirby, is evidently one of the varieties of the species afterwards described, from Alaska, as *N. maritimus*, Mann.

27. *N.* **pygmæus**, Kirby, seems to be an unusually small specimen of *N. defodiens*, Mann. The form of the prothorax is a character of great importance in the grouping of the species of this genus, but was unfortunately not described by Mr. Kirby with sufficient minuteness to permit his species to be properly referred without inspection of the types; on the other hand, the form and size of the rhinarium, upon which, with very small series of specimens, he laid great stress, is of no specific value.

28. *Cryptophagus* **concolor**, Kirby, belongs to *Triphyllus*, and was afterwards described as *T. ruficornis*, Lec.

29. *C. humeralis*, Kirby, is merely a paler specimen of the same species.

30. *Attagenus* **cylindricus**, Kirby, is a very elongate species with the prothorax densely punctured; it is quite distinct from any other known to me.

31. *Byrrhus* **concolor**, Kirby, is a species of *Cytilus* which differs from the American form of *C.* **varius** (*alternatus*, Say) by the scutellum being clothed with black, instead of golden, hair.

32. *B. picipes*, Kirby, is the same species afterwards described as *B.* **geminatus**, Lec. *B.* **Kirbyi**, Lec., is much more robust and more obtuse behind.

33. *Telephorus mandibularis*, Kirby, is *T.* **fraxini**, Say. The specimen labelled by Mr. Kirby "*T. ater* (Linn.)" does not seem to differ.

34. *T.* **Samouelli** and *T.* **Westwoodi**, Kirby, are distinct and well-defined species, not known in other collections.

35. *Leptura longiceps*, Kirby, is *Acmæops* **strigillata** (Fabr.), an abundant species in the northern parts of both continents.

36. *L.* **longicornis**, Kirby, = *Acmæops marginalis*, Lec. The elytra vary greatly in colour: sometimes they are yellow, with a sutural black stripe; sometimes, by the extension of the discoidal black vitta, they become almost entirely black.

II. Types of Mr. Newman (British Museum).

37. *Feronia* **mœrens**, Newman, = *Pterostichus flebilis*, Lec. I am disposed to believe that this and *P. adjunctus*, Lec., are only elongate forms of what I determined as *P.* **coracinus** (Newm.). No type of the last-named could, however, be found in the boxes which were shown me.

38. *F. picipes*, Newman, = *P.* **stygicus** (*F. stygica*, Say, *bisigillata*, Harris).

39. *F.* (*Pœcilus*) *atrata*, Newman, = *P.* **permundus** (Say). This species belongs to a peculiar group of *Pterostichus*, which, in the 'List of North-American Coleoptera,' I have named *Peristethus*. It resembles *P.* **fallax**; but the posterior extremity of the prosternum is marked with a marginal line, as in *Pœcilus*. The *P. atratus* of my List is a totally distinct and, as yet, undescribed species from Winnipeg, in which the lower joints of the antennæ are strongly carinate, as in other *Pœcili*.

40. *F.* **orbata**, Newman, = *Evarthrus conviva*, Lec. The species I have distributed and described up to this time as Mr. Newman's *orbata* is quite distinct, and must resume the name *E.* **sodalis**, Lec., under which I have made known its most abundant form. *Evarthrus fatuus*, Lec., and *F. corax*, Lec., are also varieties of *E. sodalis*.

III. Types of Mr. Walker (British Museum).

41. *Calosoma irregulare*, W. p. 312. The two specimens belong to a variety of *C.* **tepidum**, Lec., with the golden foveæ of the elytra remarkably brilliant, almost as much so as in *C.* **calidum**.

42. *Callisthenes pimelioides*, W. p. 312, = *C. Zimmermanni*, Lec. The large series of specimens in my collection shows every gradation from this very rough form to one in which the elytra are nearly smooth: they are all races of *Calosoma* **luxatum**, Say.

43. *Carabus bicolor*, W. p. 313, = *Calosoma* **laqueatum**, Lec.

44. *Omaseus colligatus*, W. p. 314, = *Pterostichus* (*Bothriopterus*) **oregonus**, Lec.

45. *Amara* **extensa**, W. p. 314, is a short stout *Harpalus.* The dorsal puncture on each elytron is quite distinct. I had not time to make such a detailed examination as would enable me to identify the species.

46. *A. communis*, W. p. 315, =*A.* **impuncticollis**, Say.

47. *Harpalus defixus*, W. p. 316. I did not see the specimens of this species: it is probably *H.* **cautus**, Dej.

48. *Peryphus æqualis*, W. p. 316, =*Bembidium* **planatum**, Lec.

49. *Laccophilus maculosus*, W. p. 317, =*L.* **decipiens**, Lec. =*L. truncatus*, Mann.

50. *Atemeles reflexus*, W. p. 317, =*A.* **cavus**, Lec.

51. *Tropisternus binotatus*, W. p. 318, =*Hydrophilus* **limbatus**, Lec.,—the variety with the basal margin of the elytra pale.

52. *Philhydrus* **lividus** (Forster), W. p. 319. Not examined. The mesosternum must be seen before this species can be properly identified.

53. *Saprinus consimilis*, W. p. 319, is *S.* **oregonensis**, Lec., and is not at all allied to *S.* **assimilis** (Payk.), but to *S.* **lugens**, Er.

54. *Necrophorus conversator*, W. p. 320, =*N.* **pollinctor**, Lec. My species has priority over the one described by Mannerheim under the same name, which is, moreover, a variety of *N.* **maritimus**, Mann.

55. *Cremastochilus armatus*, W. p. 320, =*C.* **angularis**, Lec.

56. *Anomala contermina*, W. p. 321, is a small species of *Lachnosterna* belonging to the *Trichesthes* group: the punctures are not very dense, but equally strong upon the prothorax and elytra; but the hairs of the former are longer; the epistoma is rounded, and the margin is very strongly reflexed. It is probably not different from *L.* **tristis** (Fabr.)=*M. pilosicollis*, Knoch, which is very widely distributed in North America.

57. *Rhizotrogus collocatus*, W. p. 321, =*Phobetus* **testaceus**, Lec.

58. *Ancylonycha nigropicea*, W. p. 322, =*Diplotaxis* **brevicollis**, Lec.

59. *A.* **consequens**, W. p. 322, is a smaller species of *Diplotaxis*, more strongly punctured and with the epistoma less reflexed. I cannot identify it without reference to the series in my collection or to my monograph of the Melolonthidæ of the United States.

60. *A.* **uninotata**, W. p. 323, is a *Lachnosterna* of the form of *L.* **fusca**, but smaller, with the punctures of the prothorax

sparse and distinct, but not coarse. I cannot from memory name this species, if it has been previously described.

61. *Serica crassata*, W. p. 323, = *S.* **anthracina**, Lec.

62. *Ancylochira ornata*, W. p. 324, is a series of specimens of *A.* **Langii**, Mann.

63. *Adelocera vetusta*, W. p. 324, = *A.* **cavicollis**, Lec.

64. *Athous quadrivittatus*, W. p. 325, is an immature specimen of *Corymbites* **lateralis**, Lec., with pale elytra.

65. *Limonius consimilis*, W. p. 325. This species has been described; but I cannot name it from memory. The epistoma is subtruncate and broadly rounded; the prothorax is very shining and sparsely punctured, with the hind angles acutely carinate; the elytra are opaque, striate, with the intervals densely punctured.

66. *Diacanthus semimetallicus*, W. p. 325, is the western race of *Corymbites* **æripennis** (Kirby), but has the prothorax unusually dull and opaque. I have described it as *C. tinctus.*

67. *Clerus sobrius*, W. p. 326, is the ancient and well-known *C.* **sphegeus**, Fabr.

68. *Iphthimus servilis*, W. p. 326, is the typical form of *I.* **serratus**, Mann., with deep elytral striæ.

69. *I. servator*, W. p. 327, does not differ in any important respect.

70. *I. subligatus*, W. p. 327. A more finely striate race of the same species, approaching *I.* **sublævis**, Bland.

71. *Eleodes* **subtuberculata**, W. p. 328, is a species resembling in form *E.* **extricata** (Say); but the elytra are granulated instead of punctured.

72. *E. convexicollis*, W. p. 328, = *E.* **obscura** (Say), ♀.

73. *E. conjuncta*, W. p. 329, = *E.* **obscura** (Say), ♂.

74. *E. binotata*, W. p. 329, is of the same form as *E.* **hispilabris** (Say), *sulcata*, Lec.; but the elytra are only feebly striate, as in *E. nupta*, Lec., from New Mexico. Comparison is necessary to determine whether it is a distinct species or a race of *E. hispilabris.*

75. *E.* **latiuscula**, W. p. 329, resembles in form *E.* **quadricollis**, Esch., but the prothorax is slightly narrowed behind, and the elytra are not punctured, but densely granulated, and obsoletely striate. It is perhaps *E.* **subaspera**, Lec., but my remembrance of that species is not so distinct as to enable me to decide with certainty.

76. *Helops inclusus*, W. p. 330. I did not see the type of this species; but the description indicates that it is either *H.* **lautus** or *H.* **pernitens**, Lec.

77. *Lytta* **immerita**, W. p. 330, is a black *Epicauta*, uniformly clothed with short cinereous pubescence.

78. *Nemognatha bicolor*, W. p. 331, = *N.* **apicalis**, Lec., var.

79. *Rhynchites* **congrua**, W. p. 331, is a small bluish-black species, with the prothorax and elytra equally coarsely punctured; the latter are not at all striate.

80. *Eutrypanus* **princeps**, W. p. 331, is very similar to the New-Mexican *Ædilis* **spectabilis**, Lec., figured in my memoir on the Coleoptera of Kansas and New Mexico, but is perhaps different.

81. *Typocerus cervinus*, W. p. 332, = *Toxotus* **spurcus**, Lec.

82. *Toxotus perductor*, W. p. 333, is one of the varieties of *Leptura* (*Stenura*) **obliterata**, Hald.

83. *Clythra bisignata*, W. p. 333, = *Saxinis* **saucia**, Lec.

IV. Types in Parisian Collections.

84. *Amblychila Piccolominii*, Reiche. The type in the collection of Baron Chaudoir is a slender male of *A.* **cylindriformis**, Say, with the punctures of the elytra less deep than usual, and the foveæ more numerous. I have a specimen from Fort Union, New Mexico, which resembles it in these respects.

85. *Cicindela* **blanda**, Dej., = *tarsalis*, Lec. The female of this species has the elytra feebly but distinctly sinuate obliquely at tip, and the outer angle of the sinuosity is quite obtuse; the base of the prothorax is slightly flattened and deeply impressed at the hind angles, somewhat as in *C.* **lacerata**, Chaud. It is therefore quite distinct from *C.* **cuprascens** and *C.* **macra**, Lec.

86. *Omophron nitens*, Chaud., is *O.* **nitens**, Lec., a species found in Kansas and Texas. The species from Louisiana sent to Baron Chaudoir by the late Mr. Guex, as my *O. nitens*, and naturally considered by him as such, is sufficiently distinct, by its narrower form, to take place as a separate species, for which, when it is fully described, another name will be required.

87. *Cychrus Germari*, Chaud., = *C.* **Andrewsii**, Harris.

88. *C.* (*Sphæroderus*) *granulosus*, Chaud., is the race of *C.* **Lecontei** (Dej.) which I named *C. Brevoorti*.

89. *C.* (*S.*) *Schaumii*, Chaud., is *S.* **nitidicollis**, Chevr. This well-known species, conspicuous for its large size in the group to which it belongs, is not uncommon in Virginia and Ohio, but was first described as occurring in Newfoundland.

90. *C.* **ventricosus**, Dej. After a careful examination of all the specimens of this and the allied species in the collections of Paris, I find no correction to be made in the synonymy given by me in the brief synopsis published in the 'Transac-

tions of the American Entomological Society,' i. 61. The synonymy of the 'List of Coleoptera of North America' is erroneous.

91. *Pasimachus viridans*, Lec. = *P.* **mexicanus**, Gray.

92. *Pseudomorphus* **Pilatei**, Chaud., is closely allied to, and probably identical with, *P. Cronhitei*, Horn; the former was collected in Yucatan, the latter in California.

93. **Anisotarsus**, Chaud. This genus is precisely equivalent to *Eurytrichus*, Lec., and has priority over the latter.

94. *Selenophorus* **Beauvoisii**, Dej. This species should be struck from the list of Coleoptera of North America: it is abundant in the Antilles, but does not occur in the United States.

95. *Dacnochilus lætus*, Lec., does not differ from *D.* **angularis**, Harold & Gemminger (*Lithocharis angularis*, Er.).

96. *Lispinus* **rufescens**, Lec., belongs to the genus **Ancæus**, Fauvel.

97. *Hololepta* **excisa**, Marseul, must be removed from the list of species of the United States: it is quite abundant in Mexico; but the only specimen labelled "Am. bor." in M. de Marseul's collection came from a source in which the localities were not accurately stated.

98. *Platysoma* **cylindroides**, Marseul. One specimen is labelled "California," on the authority of M. Boheman. As many of the localities given in the 'Eugenies Resa' by that author are erroneous, I do not think there is sufficient evidence to warrant the introduction of this species into the fauna of the United States.

99. *Omalodes texanus*, Marseul. The single specimen of this species does not differ appreciably from the common Mexican *O.* **grossus**. It came from the Pilate collection, and was perhaps erroneously labelled.

100. *Hister* **cavifrons**, Marseul. There is no North-American specimen of this species in M. de Marseul's collection: all are ticketed as from Mexico and "Et. Un., Venezuela." The label last mentioned gave rise to the confusion in localities by which it has been recorded as a North-American species.

101. *H.* **californicus**, Marseul. Collected by Dr. Garbiglietti in Mexico, where it is not uncommon. A single specimen has been labelled "California," but probably in error.

102. *Epierus* **coproides**, Marseul. One specimen is labelled "Am. bor., Laferté," and two from South America. Probably not found within the United States.

103. *Scaptolenus femoralis*, Lec. (*nec* Chevr.). I have seen,

in the collection of M. Sallé, that the species found in Texas and in the western part of Louisiana is quite different from the Mexican *S.* **femoralis**, with which I confounded it. The published descriptions of the two species will enable them to be easily distinguished.

104. *Ectopria*, Lec. This genus, which represents in North America the European **Eubria**, does not appear to be sufficiently distinct from the Mexican genus **Dicranopselaphus**, Chevr.

105. *Platydema* **pallens**, Lap. This species is found in South America, and must therefore be erased from the list of the Coleoptera of North America. I have not seen *P.* **quadrimaculata** and **cyanea**, Lap., nor *Hoplocephala* **chalybea** and **collaris**, Lap., but believe that they were wrongly attributed to North America at a time when geographical accuracy in localities was esteemed of less importance than at present.

106. *Megetra* **cancellata** (Er.). This Mexican species is quite distinct from the New-Mexican and Arizona one which I published under its name, but which, with the study of a larger series of specimens, I think is a variety of *M.* **vittata**, Lec., with irregular markings.

XL.—*Note on Ælian's Wart-Hog.* By P. L. Sclater, M.A., Ph.D., F.R.S.

In the 'Annals' for August last (*anteà*, p. 190) Dr. Gray has proposed to found a new species of wart-hog (*Phacochœrus Sclateri*) upon an animal now living in the gardens of the Zoological Society of London. On the same page Dr. Gray had already stated his belief that this animal was "only the usual form of the female African wart-hog," *i. e.* the *Ph. æthiopicus*. How the same specimen could be at once the type of a new species and the female of a well-known one, it is not easy to understand.

In a second note on the same subject, in the following number of the 'Annals' (*anteà*, p. 263), Dr. Gray acknowledges his error in "believing" that the before-mentioned animal could be the female of *Ph. æthiopicus*, but pays me the additional compliment of supposing that it may not be a wart-hog at all, and that it is possible that I do not know the difference between *Sus* and *Phacochœrus*!

I had hoped that the October Number of the 'Annals' would contain a further communication from Dr. Gray on the subject, in rectification of his second error; but such

not having been the case, I think it right in the interests of science to state that the so-called *Phacochœrus* sive *Sus Sclateri* of Dr. Gray is, in my opinion, simply a female of the well-known *Phacochœrus Æliani*, Rüppell. It is quite true, as Dr. Gray has pointed out, that the animal in the Society's Gardens has the ears rather more naked than is represented in Rüppell's figure (Zool. Atlas, tab. 25); but in other respects the animal in question perfectly agrees with the figure, and with Dr. Cretzschmar's excellent description in the letterpress.

In my note on the arrival of this animal (Proc. Zool. Soc. 1869, p. 276) I have already pointed out the most obvious external differences between it and the *Phacochœrus æthiopicus*, of which the fine pair presented to the Society, in May 1866, by H.R.H. the Duke of Edinburgh, are still living in the Society's gardens. Although we have only the female of *Ph. Æliani*, yet the comparison of the latter with the corresponding sex of *Ph. æthiopicus* will be sufficient to show that those naturalists (F. Cuvier, Cretzschmar, and Sundevall) who have distinguished the two species had ample grounds to go upon as far as external appearance goes.

As regards the remarkable and well-known difference in the dentition of the two *Phacochœri*, viz. the permanent presence of two upper incisor teeth in *Phacochœrus Æliani*, which are entirely absent in *Ph. æthiopicus*, I have re-read what Dr. Gray has written upon this subject in his 'Catalogue of Carnivorous, Pachydermatous, and Edentate Mammalia,' but have quite failed to see that he has upset the conclusions arrived at upon this point by F. Cuvier, Cretzschmar, Owen, Sundevall, and Van der Hoeven. The localities marked on specimens in the British Museum are so frequently erroneous that no argument can be based upon them; and besides, from what Sundevall has said*, it appears certain that both species occur in South Africa, though perhaps not quite in the same district. I may add that Mr. Blanford, who recently examined the question when engaged upon his work on Abyssinian zoology, likewise came to the same conclusion, viz. that Dr. Gray had made a great mistake in attempting to unite these two well-marked species†.

* Œfv. af K. Vet. Akad. Förh. 1846, p. 121.

† Blanford, Geology and Zoology of Abyssinia, p. 242.

XLI.—*On a supposed new Species of Humming-bird from the Juan-Fernandez Group of Islands.* By JOHN GOULD, F.R.S.

MUCH interest has of late years been excited in the minds of ornithologists respecting the Humming-birds of the above-mentioned islands, in consequence of some of the scientific men of Santiago de Chile having stated that the fine red bird so long known to us as *Eustephanus Fernandensis*, and the equally beautiful green bird called *Eustephanus Stokesii* are not really distinct, but opposite sexes of one and the same species. Hitherto all the specimens in Europe, and also in Chile, have, I believe, been collected in the most eastern of the islands in question; but Mr. Leybold has lately despatched a collector to Mas a Fuera, which, as its name implies, is the furthest off—say, at a rough guess, about thirty miles to the westward. This man brought thence a single green and several red examples, which latter differ a little, and but little, from the ordinary red birds of Juan Fernandez. The sex of the green bird was not ascertained by dissection. I observe, however, that it differs from any of the examples collected by Captain King, Mr. Bridges, and others who have visited those islands during the last forty years. I therefore propose to give this green bird a specific appellation, and in calling it *Eustephanus Leyboldi* I am only paying a just compliment to a gentleman in Santiago who is endeavouring by all the means in his power to set this vexed question at rest, and to ascertain whether there be one, two, three, or four species of Trochilidæ inhabiting that distant group of islands in the wide Pacific.

Eustephanus Leyboldi

has a glittering green crown, and is in many respects very similar to the bird usually called *E. Stokesi*, but differs in having a longer bill, and in the spots on the throat being bronzy and disposed in lines down that part of the under surface and the flanks, as in *E. galeritus*, instead of being generally dispersed over the throat and clustered on the face as in *E. Stokesi*; but the greatest difference between the two consists in the colouring of the tail-feathers, those of *E. Stokesi* having their outer webs green, and their inner ones wholly white, while in the present bird the outer webs and the basal portion of the inner ones are green, and only the apical portion of the latter white.

Total length $4\frac{5}{8}$ inches, bill $\frac{15}{16}$, wing $2\frac{7}{8}$, tail 2, tarsi $\frac{3}{8}$.

Habitat. Mas a Fuera, one of the Juan-Fernandez group of Islands.

XLII.—*List of Coleoptera received from Old Calabar, on the West Coast of Africa.* By Andrew Murray, F.L.S.

[Continued from p. 176.]

Lamiidæ.

Apomempsis, Pasc. Journ. Ent. ii. p. 278.

Apomempsis bufo. Pl. III. fig. 11.

Phrissoma bufo, Chevr. Rev. et Mag. d. Zool. 1855, p. 186.

Alatus, bigibbosus, remote et fortiter punctatus et obscurus; capite antice truncato et grosse punctato, declivi in vertice et impunctato, in longitudinem anguste sulcato, inter antennas profunde emarginato, clypeo labioque fulvo-setosis; mandibulis atris; oculis parvis, bifidis; antennis undecim articulis, tertio quartoque longissimis; thorace elongato, antice posticeque recto, medio gibboso, nigricante et binodoso, lateribus breviter unispinoso supra et ultra medium; scutello lato, triangulari; elytris basi depressis (bispinosis), subito dorso gibbosis cum seriebus duabus tuberculorum, ad marginem obtuse serratis; abdomine quinque segmentis; femoribus tibiisque versus medium nigro annulatis, tibiis in apice extus subemarginatis, fulvo pilosis.

Long. 5 lin., lat. 2½ lin.

Winged, bigibbous, remotely and coarsely punctured, and obscure. Head deeply emarginate between the antennæ, narrowly longitudinally sulcate. Eyes small and bifid. Antennæ with eleven articles, third and fourth very long, the rest to the apex small. Thorax gibbous in the middle, blackish and binodose, with the sides unispinose above and beyond the middle. Scutellum broadly triangular. Elytra depressed at the base (bispinose), abruptly gibbous on the back, with two rows of tubercles, obtusely serrate on the margin. Abdomen with five segments. Thighs and tibiæ annulated with black near the middle; tibiæ fulvo-pilose and subemarginate on the outer side at the apex.

Removed from the genus *Phrissoma*, by Mr. Pascoe, into a new genus, *Apomempsis*, established by him to receive it. This is adopted by Prof. Lacordaire, and the genus ranked by him among the Parmenidæ. Mr. Pascoe may be right in separating it from *Phrissoma*, although it seems to me that it would have been better to have widened the diagnosis of that genus to receive or retain it; that, however, is not of much consequence: but it seems to me that it is both in opposition to its natural affinities and its geographical distribution to remove it into the Parmenidæ. There is no other of

the Parmenidæ from Africa except a single species at the Cape; and indeed the whole of the true Parmenidæ are of the element I have elsewhere called microtypal, of which the European is the type, and which are dispersed over Europe, North America, California, Chili, New Zealand, Australia, and neighbouring lands, to which they could obtain access. But West Africa is not of them.

I place it alongside *Phrissoma*, a form peculiar to Africa, with which it seems to have most natural affinity.

Rare.

Velleda, J. Thoms.

Velleda callizona. Pl. III. fig. 12.

Parmena callizona, Chevr. Rev. et Mag. d. Zool. 1855, p. 186.
Velleda murinum, J. Thoms. Arch. Ent. ii. 189 (1858).

Alata, impunctata, plumbea; capite antice truncato, angustissime sulcato, inter antennas angulose emarginato; palpis rufo-piceis; antennis undecim articulis, tertio longissimo, primo et quarto subæqualibus, ultimis brevibus; thorace cylindrico, antice posticeque recto ibique prope arcte bistricto, lateribus acutissime spinoso; scutello albo; elytris ad apicem sensim latioribus et dorso convexis, breviter truncatis, apice extusque obtuse unidentatis, punctato-striatis, cinereo indutis cum fasciis duabus atro-brunneis, duabus albis; tibiis quatuor posticis in summo extus subampliatis, pallide setosis.

Long. 5 lin., lat. 2 lin.

Winged, impunctate, lead-coloured. Head truncate in front, very narrowly sulcate, angularly emarginate between the antennæ. Palpi rufo-piceous. Antennæ with eleven articles, the third the longest, the first and fourth subequal, the last short. Thorax somewhat cylindrical, straight both in front and behind, and twice almost narrowly constricted, the sides very sharply spined. Scutellum white. Elytra gradually widened towards the apex, and convex on the back, shortly truncate at the apex, and externally with an obtuse tooth, punctate-striate, cinereous, with two blackish-brown bands and two white ones. The four posterior tibiæ slightly dilated on the outer side.

Rare.

Acmocera.

Acmocera compressa, Fab. Syst. El.

Acmocera subundata, Chevr. Rev. et Mag. d. Zool. 1857, p. 107.

M. Chevrolat described my specimens of this insect as di-

stinct from the *A. compressa*, Fab., from Guinea; and the distinctions that he pointed out were—that the colour was more obscure, and especially that the anterior thighs had not the spined keel on their upperside, which is a remarkable character in that species. A larger series of specimens, received since I supplied him, has enabled me to see that neither of these characters is specific. The colour is somewhat variable, and one or two individuals have the ground-colour bluish grey instead of fawn-colour as it usually is both in the Old-Calabar specimens and in those from Guinea; and although in the majority of specimens there is no superior spine on the anterior thighs, there is considerable difference in their degree of development: in one specimen the spine is as fully developed as in any of the typical examples of *A. compressa*, with which in other respects it wholly agrees, and, but for this spine, is undistinguishable from the other specimens from Old Calabar. The femoral spine may be a sexual character, but it seems to me to be rather an accident of growth. If sexual, it would not be universal in Guinea and only rarely present in Old Calabar.

The head is fawn-coloured, black and smooth behind each eye, angularly hollowed between the antennæ, deeply longitudinally grooved; it is vertical, and the mandibles are broad, flat, black, and covered with longitudinal wrinkles at their base, smooth and sharp at the point. Palpi long and black. Labrum large, rounded, and covered with a thick greyish pubescence. Clypeus cut straight. Eyes black, rounded below, feebly emarginate in front at the upper part. Antennæ shorter than the body, black, ringed with ash-colour; the first article is tumid and scabrous on the outside, the third is twice the length of the fifth, and the last article is terminated with a claw. Thorax transverse, straight, grooved near the anterior and posterior margins, ash-coloured and depressed in the form of a sort of cross on the back, lateral spine tolerably sharp. Scutellum large, short, semirounded, fawn-coloured. Elytra short, deep, convex, broader than the head and the thorax, rectangular at the base and to the outside of the shoulder, rounded at the apex to the suture, which terminates in a right angle and rises until near the middle; the shoulder has a triangular yellow patch; and each elytron has, behind the middle, two flexuous whitish bands, which are not well defined; there are also indistinct longitudinal ridges with an indistinct wrinkled punctation. Legs moderate; thighs suddenly swollen, in some instances the anterior thighs rising continuously into a prominent flat triangular spine; tibiæ arched near the knees, keeled longitudinally below, blackish,

ash-coloured in the middle; tarsi grey; claws simple, robust, black. It is about 6 or 7 lines in length and 2½ in breadth.

It seems to me that the proper place for this species is among the Phrissomidæ, and next to *Velleda*, to which it has much general resemblance.

BATOCERA, Cast.

Batocera Wyliei, Chevr.

Rev. et Mag. d. Zool. Feb. 1858, p. 54.

Batocera Albertiana, J. Thoms. Archiv. Entom. ii. 457 (1858).

Fusca; capite impunctato, anguste sulcato; antennis infra breviter spinosis, cinereis, sed ad basin infuscatis; thorace transversim sinuoseque decies sulcato, spina laterali valida; elytris convexis, parallelis, a basi usque medium versus nigro tuberculatis, maculis irregularibus plurimis cervinis, media majore, spina humerali et suturali aciculatis, limbo marginali nigricante; pedibus corporeque infra (cum vitta laterali leucophæa) fusco-plumbeis.

Long. 24 lin., lat. 9 lin.

With the perfect facies and characters of the genus. The most striking differences that on the most superficial view present themselves from *B. rubus* are the greater length, especially of the elytra, and comparative narrowness and greater roughness and coarseness of texture or surface. Ashy brown, more or less obscure. Head impunctate, vertical in front, narrowly channelled in the middle. Mandibles and eyes black. Labrum narrow, transverse, yellowish. Antennæ of the length of the body, punctate, flattened above, and ash-coloured; first article obscure, strong, swollen at the top, with an oblique cicatrice and tubercular asperities on its outer side; second article very short; third very long and, as well as the fourth to the eighth inclusive, armed below with small sharp spines, which diminish both in number and length towards the latter. Thorax a little narrower than long, straight and rounded cylindrically in front, deeply bisinuate behind, obscure on the sides, with about a dozen transverse wrinkles, most of them sinuous, the three next the base alone straight; lateral spine very robust, sharp, blackish, and marked with a deep impression at the base. Scutellum large, subconical, although rounded. Elytra elongate, narrow, parallel, convex, bearing small, black, flattened, smooth tubercles from the base to beyond the middle; these become smaller and more numerous as they recede from the base: there is a large irregular patch of yellowish ash-colour about the middle; other smaller spots of

the same colour are dispersed here and there to the apex; the shoulder is raised, and bears a spine; the apex of the suture is also spined and sinuate; the margin is feebly raised and blackish. Legs and body below obscure lead-coloured; sides of the breast and abdomen yellowish; posterior margins of the abdominal segments fringed with yellow hairs, the last segment emarginate at the apex.

This species was described and published (*loc. cit.*) by M. Chevrolat in Feb. 1858, and again, in the same year, in the 'Archives Entom.,' by M. James Thomson, under the name of *B. Albertiana.* That work appeared in numbers; and as it does not occur until p. 457, there is little doubt that it must have been in some part of the year subsequent to February. M. Chevrolat's name therefore is entitled to the precedence.

It was named by M. Chevrolat, at my suggestion, in honour of Mr. Wylie, one of the Old-Calabar missionaries, to whose assistance I was very particularly indebted. He returned to this country only to die—another of the valuable lives which have fallen before that baleful climate.

The genus *Batocera* is an Indian form. The type *B. rubus* is found almost all over India and the Indo-Malayan district; and numerous other species have been found in the Malayan and New-Guinea district, and in China. Its appearance in Africa is to be explained by the former union of Africa and India, and the common origin of a large number of their inhabitants.

PHRYNETA, Cast. Suites à Buff. Ins. 474.

1. *Phryneta brunnicornis*, Guér. Règn. An. Ins. 239.

Phryneta bisignata, Dej.

Dejean's name is much the more characteristic, the most striking feature in the species being the possession of a dark brownish-black patch on the middle of the outer side of each elytron, similar in shape and hue to that in *Monohammus lateralis* from Java.

This species is known from Angola. I have received one specimen from Old Calabar.

2. *Phryneta obscura*, Oliv. Ent.

Lamia spinator, Fab. Syst. El.
Phryneta rustica, Dej. Cat. ed. 3. p. 368.

Not very rare.

3. *Phryneta luctuosa.*

Affinis *Ph. obscura*, colore saturatiore, et elytris cum maculis transversis fere in fasciis convexis dignoscitur.

Long. 10 lin., lat. $3\frac{1}{2}$–4 lin.

Very like *P. obscura*; but the colour of the pubescence is bluish grey instead of ash-grey, and the black markings on the elytra are more distinctly in bands—the second band behind the middle being the longest, but reaching neither to the suture nor the external margin, waved and broadest next the suture; the other marks only a little longer than in *P. obscura*. The thorax has the raised parts more distinct and flat on their surface.

Not frequent.

PHRYSTOLA*, nov. gen. vel subgen.

The species on which I have founded this genus or subgenus is closely allied to *Phryneta* and *Pachystola*. M. Chevrolat described it as a *Phryneta*; but the facies is not that of *Phryneta*, being less robust and more elongate. It is nearer the form of *Pachystola*, but more convex on the back (*Pachystola* has the back somewhat depressed). The antennæ in both *Phryneta* and *Pachystola* are short, rarely exceeding the body in length. In this insect they are longer than it, and, what is of more importance, they have not the wire-like uniform thickness of *Pachystola* nor the flatter thickness of *Phryneta*. They are, like the antennæ in *Prosopocera*, rather fine, especially towards the apex, and each article defined by being a little thicker at the apex; the first article, however, is, like that of *Phryneta*, rounded in at the apex, and with scarcely any cicatrice. The head is hollowed between the antennæ, and raised on each side at their base. The thorax is more elongate than them; and although it has elevations, they are on a different pattern, viz. a central dorsal, elongated raised space being the most notable point. Abdomen with five segments, first and fifth very broad, intermediate equal. Tubercle of the sternum smaller than in most of the species of *Phryneta* and *Pachystola*. In other respects it corresponds with *Phryneta*.

Phrystola cæca.

Phryneta cæca, Chevr. Rev. et Mag. d. Zool. 1857, p. 75.

Cinerea, obscura, nigro signata; capite lato, antice recte truncato, sulco longitudinali angusto; mandibulis oculisque (postice cinereo marginatis) nigris; antennis gracilioribus, corpore vix longioribus, infra parce pilosis, nigricantibus; thorace cinereo, in medio et lateribus nigricante, antice recto, basi profunde bisinuato, anguste trisulcato, in medio dorso tuberculum oblongum antice trinodosum et longitudine

* Name compounded of *Phryneta* and *Pachystola*, in allusion to its partaking of the characters of both.

sulcatum emittente; spina laterali erecta, valida, acuta, antice basi tuberculata posticeque profunde constricta et in latitudinem sulcata; scutello fere semirotundato, cinereo, nigroque lateribus; elytris cinereis, thorace multo latioribus, basi sinuosis, in humero parum scabrosis et foveolato-tuberculatis, macula humerali magna trianguliformi, macula communi rotundata infra scutellum, vitta obliqua e margine ad suturam ducta (puncto ocellari griseo signata pone suturam) notulisque duabus transverse positis ante apicem nigris; pectore maculis duabus lateralibus albidis; abdomine lineis tribus obsoletis nigris.

Long. 10–13 lin., lat. 4 lin.

Obscure cinereous. Thorax with the middle and the sides blackish. Elytra with the following blackish markings:—(1) a rounded patch, common to both, behind the scutellum; (2) a large triangular humeral patch; (3) an oblique band, which starts from the margin at the place where the posterior thighs show themselves, and proceeds towards the suture, which it does not reach; at the apex of the band there is an ash-coloured oculiform spot; (4) lastly, two small marks (the exterior of which is smallest) placed transversely before the apex. Head broad, cut straight in front, angularly emarginate between the antennæ, narrowly grooved. Mandibles and eyes black. Antennæ blackish, about the length of the body. Thorax a little longer than broad, furnished on the disk with an oblong tubercle, longitudinally grooved, and with three less prominent elevations in front. Towards the side, on the same level, is another rounded tubercle resting on the lateral spine (which is robust, raised, very sharp, and transversely grooved), and three transverse grooves, of which two are along the base; that in front does not exist except below and on the sides. Scutellum ash-coloured, black on the sides. Elytra sinuous, projecting and rounded at the base and exterior of the shoulder, which bears a few large reticulated punctures, denticulated and slightly tuberculate on the sides, convex, a little narrowed towards the apex, and each regularly rounded at the apex. Legs unarmed, tolerably strong and thick, of an obscure grey, shaded with black; thighs grooved longitudinally below; tibiæ widened on the external side before the middle; tarsi with the first and second articles broadly and shortly triangular, third broadly bilobed; claws robust, simple. Body below of an obscure ash-colour; breast with two lateral white patches. Abdomen with three obsolete black lines.

Rare.

[To be continued.]

BIBLIOGRAPHICAL NOTICES.

On European Spiders. Part I. *Review of the European Genera of Spiders, preceded by some Observations on their Zoological Nomenclature.* By T. Thorell, Ph.D., Junior Professor of Zoology in the University of Upsala. 4to. Upsala, 1869–1870.

A general work on any order of the class Arachnida is of such rare occurrence that the mere appearance of such a one as that which stands at the head of this notice may be said to mark an epoch in arachnological literature. Nor is the value of the 'Review of the European Genera of Spiders' lessened by the unprecedented fact of its being written in English by a native of Sweden, and printed and published at Upsala, in that country. In fact the reader will not go very far in the perusal of Dr. Thorell's volume without finding a vigour and terseness of expression which many English writers would do well to imitate: in the expression, for instance, "we *go out from*" (p. 4) for "we *commence with or from*," we have, in addition to vigour and terseness, a preference of Saxon to a Latin derivative; while other traces of foreign authorship, if not entirely absent, are yet marvellously few and far between.

The plan of the work before us (Part I.) seems to be to construct a systematic and synonymic view or table of families and genera of European Spiders, taking as a special text the *general* work of M. Simon (Histoire des Araignées) in combination with the *restricted* (or, as Dr. Thorell aptly terms them, "*faunistic*") works of M. Westring ('Araneæ Suecicæ,' Gottesburg, 1861) and Mr. Blackwall ('A History of the Spiders of Great Britain and Ireland,' London, 1861–64). After some lengthened observations on nomenclature and the rules respecting priority (in which Dr. Thorell mainly agrees with the canons laid down by a committee appointed by the British Association to consider the subject, and whose report is published in Ann. & Mag. Nat. Hist. ser. 1. vol. xi. p. 259 *et seq.*), the plan of his work is further detailed (pp. 14–19); and to this succeeds a short general account of the three works above mentioned, which are used as the basis of the author's systematic view. The short accounts of these works contain some good, though sharp, criticisms; these are lavished freely (and not undeservedly) upon both Mr. Blackwall's and M. Simon's works. The latter would certainly appear to be peculiarly open to adverse criticism, while, with regard to the former, Dr. Thorell does not make due allowance for what perhaps he was ignorant of, the unusual hindrances and difficulties under which Mr. Blackwall laboured in his study of the Araneidea and the production of his work on British and Irish Spiders.

Dr. Thorell divides the order Araneæ (which comprises the *true* Spiders as distinguished from the Phalangidea or Harvest-men, the Acaridea or mites, the Scorpionidea and their allies) into seven *sub-orders*: these, in number, name, and contents, correspond almost

exactly to the "*families*" of Latreille*. They are again subdivided into twenty-two "families," as follows:—

Order Araneæ.

Suborder I. *Orbitelariæ.*

Fam. 1. Epeiroidæ.

Suborder II. *Retitelariæ.*

Fam. 2. Theridioidæ.
Fam. 3. Scytodoidæ.
Fam. 4. Enyoidæ.

Suborder III. *Tubitelariæ.*

Fam. 5. Urocteoidæ.
Fam. 6. Omanoidæ.
Fam. 7. Hersilioidæ.
Fam. 8. Agalenoidæ.
Fam. 9. Drassoidæ.
Fam. 10. Dysderoidæ.
Fam. 11. Filistatoidæ.

Suborder IV. *Territelariæ.*

Fam. 12. Theraphosoidæ.
Fam. 13. Liphistioidæ.
Fig. 14. Catadysoidæ.

Suborder V. *Laterigradæ.*

Fam. 15. Thomisoidæ.

Suborder VI. *Citigradæ.*

Fam. 16. Lycosoidæ.
Fam. 17. Oxyopoidæ.

Suborder VII. *Saltigradæ.*

Fam. 18. Myrmecioidæ.
Fam. 19. Otiothopoidæ.
Fam. 20. Dinopoidæ.
Fam. 21. Eresoidæ.
Fam. 22. Attoidæ.

Of the above families sixteen are considered European, and these are divided into numerous genera, some of them also into two or more *sub*families.

In the construction of these subdivisions Dr. Thorell has shown considerable boldness as well as grasp of his subject. It would be foreign to the objects of the present notice to enter into any detailed criticism upon the propriety of all the author's positions or the scientific tenability of his system; it may, however, be added that

* This is Dr. Thorell's statement (p. 42); but he gives no reference to the work of Latreille in which these "*families*" are characterized: in the only work of that author accessible to me, he (Latreille) employs the term "family" in a different sense, indicating far larger groups of the Arachnida. (*Vide* 'Les Crustacés, les Arachnides et les Insectes,' par Latreille, i. p. 213 &c. Paris, 1829.)

the European genera (120 in number) are distributed among the sixteen families in the following proportions:—

Fam. Epeiroidæ,	10	genera.	Fam. Dysderoidæ,	7	genera.
„ Theridioidæ,	19	„	„ Filistatoidæ,	1	„
„ Scytodoidæ,	4	„	„ Theraphosoidæ,	6	„
„ Enyoidæ,	2	„	„ Thomisoidæ,	14	„
„ Urocteoidæ,	2	„	„ Lycosoidæ,	7*	„
„ Hersilioidæ,	1	„	„ Oxyopoidæ,	2	„
„ Agalenoidæ,	16	„	„ Eresoidæ,	2	„
„ Drassoidæ,	13	„	„ Attoidæ,	13	„

Although nominally only treating of European Spiders, Dr. Thorell offers many excellent remarks upon extra-European and exotic genera and species. Among these remarks, however, are some which the author would probably see good reason to modify considerably with further information before him—for instance, p. 44, where a new family, Omanoidæ, as distinct from Urocteoidæ, is constructed on a hasty conclusion that the *Œcobius navus* of Blackwall does not belong (see pp. 113, 114) to the genus *Œcobius* (Lucas), to which, however, it undoubtedly does belong. Again, including in the family Epeiroidæ "all those" spiders "that spin regular so-called *geometrical* webs," Dr. Thorell was necessarily unacquainted with an undoubted Epeïrid (a native of New Zealand, and yet undescribed) observed and beautifully figured by Dr. Llewelyn Powell, belonging to the genus *Arachnura* (Vinson): this spider spins only a few irregular threads crossing each other on various planes, among twigs or small branches and stems of herbaceous plants, very similarly to some spiders of the genus *Theridion*, fam. Theridioides. Again, p. 65, where an unvarying character of the Laterigradæ is stated to be the absence of "accessory claws together with the (three) ordinary genuine claws at the end of the tarsi:" Dr. Thorell was evidently unaware that the genus *Arcys*, which he considers one of the Laterigradæ, has these accessory claws. Of course, if Dr. Thorell had been aware of this, it might have been a reason with him for separating *Arcys* from the Laterigradæ and uniting it with the Orbitelariæ, with some genera of which the position of the eyes closely unites it. There is no doubt that these two suborders (Orbitelariæ and Laterigradæ) border very closely upon each other, though, in the absence of any knowledge of the habits of *Arcys*, or of any special functions connected with the accessory claws, it would seem to be premature to separate it, on account of these claws, from a group with which it has certainly very strong structural features in common.

Again (p. 79), the distinguishing character of all the Thomisoidæ is stated to be the possession of but *two* terminal tarsal claws, whereas *Arcys* has *three*, and *Thlaosoma* (Cambr.) also three, though in the description of this last genus (Linn. Journ. vol. x. p. 273) the number of its tarsal claws is by an accidental error given as two; but this opens up again the question, referred to above, as to *Arcys* (and

* Or, including a doubtful European genus, 8.

also *Thlaosoma*) being an Epeïrid or Laterigrade. At page 43, the nearness of the genus *Otiothops* (Macleay) to *Palpimanus* (Dufour) is remarked upon; but, on account of the former's possessing an abnormal number of joints in the legs of the first pair, and the absence (as stated by Macleay, but probably erroneously) of claws at the end of the tarsi of that pair, Dr. Thorell has set up a new *family* for it (Otiothopoidæ). This would hardly seem tenable on these grounds: an abnormal number of joints would be by itself at best but a generic character, and, in another instance (gen. *Hersiliola*), Thorell has given this peculiarity just that weight; and as regards the absence of tarsal claws on the tarsi of the first pair of legs, these are exceedingly difficult to be seen in *Palpimanus*, so much so that (as Dr. Thorell remarks, p. 202) so good a naturalist as Dufour, who established the genus, repeatedly stated that it differed "from all known spiders by having *no claws on the first pair of legs*," whereas closer observation has revealed, Dr. Thorell says, no less than *three*, exceedingly minute, "quite concealed by the hairs at the extremity of the tarsus," and only to "be clearly seen with a good microscope." It does not, therefore, seem particularly captious to conclude that it is more likely that Macleay overlooked the claws in *Otiothops* than that a spider so nearly allied both in structure and form to *Palpimanus* should yet differ so remarkably in regard to the possession of these tarsal claws. A very striking character of *Palpimanus* appears to have escaped Dr. Thorell as well as Dufour; and that is the possession of but *two* spinners—a character hitherto unrecorded of any known spider, though found in a very interesting new genus lately received from Bombay, a description of which, under the name *Stenochilus Hobsonii*, will shortly be published.

It is not intended by any means in the above criticisms to detract from the great and decided merits of Dr. Thorell's work. We are indebted to him for the first general work on araneology (beyond the mere limits of a cyclopædia-article) that has ever appeared in the English language. To say that the limits assigned in all cases by Dr. Thorell to the genera and families of Araneæ will resist all efforts that might be made to alter or modify them, would be to make the very improbable assertion that the science of araneology is incapable of further modification or improvement. As it is, however, we have in this present work a text-book for English students of Araneæ which will soon be found to be indispensable to the study of British (as well as European) Spiders.—O. P. Cambridge.

Flint Chips: a Guide to Prehistoric Archæology, as illustrated by the Collection in the Blackmore Museum, Salisbury. By Edward T. Stevens. 8vo, with Illustrations. London, 1870.

Catalogues are proverbially dry reading: and it is rare to find a publication of this character both interesting and instructive. Mr. Stevens has fortunately fulfilled both these requirements of book-making, and in 'Flint Chips' has not only given us a very readable

book, but has succeeded in making even the enumeration of specimens lend its aid to the elucidation of the facts and theories he brings to our notice.

'Flint Chips' is primarily a carefully arranged Catalogue of the Blackmore Museum at Salisbury; but it is something more than this, for the author has appended to each subdivision of the sections that comprise the collection a carefully written digest of all the various subjects connected with their actual and assumed history. Thus the "Drift-series," comprising the mammalian remains from the Brick-earth and other superficial deposits, as well as those obtained from the "Bone-caves" and Peat of various parts of Europe, is prefaced by a description of the habits and characteristics of the mammals whose relics fill the museum-cases referred to at the end of the chapter.

The enumeration of the prehistoric remains from the Lake-dwellings of Switzerland and elsewhere is furnished with a description not merely of the *locale* and the circumstances under which the discoveries were made, but also with a careful account of the actual position of each series of articles in the "Relic-bed," and their probable uses and manufacture. But it is regarding the relics of the "Stone Age," in which the Blackmore Museum is especially rich, that the author has been most prolific of information, and has brought prominently forward the great lesson to be learnt by the study of these traces of human life and human labour (the lesson of the gradual development and progress of our race), which day by day are becoming more closely examined and appreciated, as furnishing those links in the history of the world with which the ages before historic times have otherwise failed to furnish us.

The "Palæolithic" period of the "Stone Age," that in which the implements were produced by primary fracture of the rock-masses, and a further completion into certain definite forms by chipping, dates far back into the prehistoric era; and the types, few in number, comprise, simply, scrapers, arrow-heads, and rough shoe-shaped adzes, which, though carefully finished by chipping, are still mere rude and barbarous efforts to supply the want of weapons and cutting-implements. The drift of England, the surface-gravels of India, the caves of France, have all furnished fragments of flint, quartzite, and other minerals capable of being split by percussive blows; and the caves of the Dordogne valley and other places have supplied, in addition, bones, horns, and teeth of animals, rudely worked, which are coeval with those early traces of human art, as well as with the mammoth, the reindeer, and the cave-bear. The probable method of "hafting" these implements, and the uses for which they may have been designed, are referred to under this branch of the subject; and admirable parallels are drawn between these theories and the known customs of existing savage nations. It is in this section of the subject that the book is especially valuable. In describing the American relics, the use of fragments of obsidian by the lower classes instead of knives, even at the present day, is pointed out; and carefully collated extracts from various authors

describing the methods now in use by the aboriginal tribes to produce implements of stone of the same typical character as those of the Palæolithic period furnish most valuable bases for conjecture, not only as to the use, but as to the actual truth of the theories advanced regarding the intention and formation, of the prehistoric relics.

Proceeding further with the subject, we find the remains of the "Neolithic" period, or that in which the implements have assumed both a higher artistic type and greater perfection of finish, largely represented in this account of the Blackmore Museum. Axes perfect in form and workmanship, and composed of the hardest materials, seem to have offered no resistance to the stubborn perseverance of the savage races; and here, again, the parallel between the facts discovered as to the manufacture of similar implements in modern times is wisely furnished. We cannot do better than quote the writer's words, as they serve to show how near an apparent relation exists between the customs and habits of modern savage races and those the date of whose history is lost in the mists of antiquity. He says, in reference to the orifices formed in the heads of the stone axes or celts, "That drilling has been effected in recent times without tools of metal, is proved by the experience of travellers. Mr. Wallace speaks of cylinders of rock-crystal four to eight inches long and one inch in diameter, which are still made and perforated by very low tribes on the Rio Negro. These are formed merely by rubbing; and the perforation is effected by twirling a flexible leaf-shoot of wild plantain between the hands against the stone, and thus, with sand and water, boring through the stone. This is said to take years to effect. Such cylinders as the chiefs wear are stated to take two men's lives to perforate."

How easy becomes the deduction that, given the same character of life, the same natural disregard of time where time is of little value, the efforts of human intellect are but to repeat themselves. One very remarkable fact, that serves very completely to link the ages of stone and metal, is adduced in the description of the grave-mounds in Ohio. These mounds, which are very numerous, occur in groups at various places on the American continent, and contain numerous stone implements of the Palæolithic type; but though copper is found in considerable quantities (probably brought from the shores of Lake Superior, where it is often found native), the discovery that it was fusible seems never to have been made; and axes of the prevailing type have been found which have been worked into the required form by simple hammering. The aborigines appear to have discovered the one property of malleability, and treated it therefore as a superior kind of stone, possessed of the valuable quality of not being liable to fracture.

In one point only we do not share the author's theories.

The grave-mounds of Ohio have proved to be extremely rich in pipe-bowls of various materials, such as siliceous slate, argillaceous ironstone, ferruginous chlorite, and marly limestones; and

these have been rudely carved to represent birds and beasts, and in some cases human heads. In the very minute description of these remains, which is moreover supplemented by good woodcut illustrations, he seems, in our opinion, to have fallen into the very common error (more especially common with archæologists) of discovering a hidden meaning, which, from their very inartistic style of execution, we should have hardly imagined the pipe-makers capable of embodying. For example, the zigzag markings on a figure assumed to be that of a swallow are suggested to be indicative of the lightning-like swiftness of the bird. It is equally possible they were crude efforts to represent feathering on the very intractable material of which this bowl is composed, the skill and tools of the workman being incapable of a more delicate rendering of nature. Again, the drawings of some very rude efforts at delineating the human face furnish an opportunity for calling attention to such details as that "the mouth is compressed, the brows contracted, giving the countenance an aspect of severity." We are far from denying that such may be the case; but it may be equally true that the task of carving a full and delicate mouth in "a compact black stone. . . . of greater hardness" would be, with indifferent tools, a matter of difficulty; and we think that the author, perhaps not unnaturally, in his desire to furnish material for conjecture and research, has gone out of his way to discover forms and æsthetic ideas of high art that, as we before remarked, never crossed the probably somewhat unimaginative brains of these ancient races. The early sketches of a child, the first rude mouldings of a sculptor, rarely go beyond portraying very feebly the external appearance of the original; the ideas that make the picture something more than a mere piece of colouring, the sculptured form something more than a mere marble image, belong to a cultivation and intellectual elevation which of themselves lead to a truer appreciation of the first principles of art, the beauty of truthfulness of form. We fail to see that the Ohio relics fulfil this primary requirement; and therefore we cannot agree with Mr. Stevens's ingenious efforts to discover in these humble imitations of life more than the fact that the inhabitants of these ancient cities were certainly great smokers, and equally great as indifferent carvers.

It is indeed unwise to bind ourselves to limited views of *types* of form, whether of flint-chips or carved figures. We must remember that similar circumstances lead to similar results, and the siliceous rocks (jasper, agate, quartz, flint, and quartzite) will break under given blows with a similar fracture, and that an uncultivated genius will produce forms generally *more or less* of the same character, with certain accidental and individual characteristics.

Space fails us to do more than refer to the description of the other American relics, full as it is of facts and numberless details of savage life bearing immediately on the subject; but, as an evidence of the completeness of the book, we may mention that even the question of the manufacture of modern flint implements (gun-flints, as well

as forgeries of more ancient relics) has not been forgotten; and a paper written by Mr. Wyatt on the latter subject has been furnished. It is satisfactory to find, with reference to these most interesting relics, that "it is a curious fact that the climax of high art in flint-work was attained at a period generally described as barbarous, then was lost as civilization advanced, and now the *modus operandi* seems altogether irrecoverable. The fine work altogether defies imitation by the highly civilized and ingenious."

'Flint Chips,' as we have seen, is not merely a descriptive catalogue; it is the briefly told history of the early human race, illustrated by the best of all examples, a careful detail of the objects described by a writer endowed with great descriptive powers and performing an evidently congenial task. In one thing only is the title of the book deceptive: it does not convey an idea of the mass of practical information, coupled with a very complete arrangement of the varied details of life in prehistoric times, as far as we can judge of them, for which Mr. Stevens's valuable work is especially noteworthy.

The Natural History of Commerce. With a copious List of Commercial Terms, and their Synonyms in several Languages. By John Yeats, LL.D. 12mo. London: Cassell, Petter, and Galpin, 1870.

Dr. Yeats tells us in his preface that he was led to the production of this little book by the desire to place within the reach of the English student the means of obtaining some definite knowledge of the nature and origin of those raw products which constitute the principal objects of commerce. Abroad, especially in Germany and Holland, he found that instruction in such matters was common; so that young men entering upon mercantile life were in a position to look at commerce from a far higher point of view than that of its apparent object—mere money-making. It seemed to Dr. Yeats that the members of the greatest commercial nation in the world ought also to have the opportunity of acquiring an intelligent knowledge of the general objects and effects of commerce; and with a view to the attainment of so desirable a consummation, he has prepared the excellent manual which we have now before us.

Works of this description may also have an effect altogether beside that which is their direct and ostensible purpose. Attracting the attention of those who would probably never sit down to read a professedly scientific work, by offering them certain practical information on points in which they are interested, they will familiarize the minds of such readers as these with certain general scientific facts, and in many cases doubtless lead to a desire for further information upon particular points, and thus serve as an inducement to the study of science on the part of those who would never have taken it up but in some such indirect fashion.

On the whole, as far as we can see, Dr. Yeats has executed his

task in a most careful and painstaking fashion, and with great success. His object being to give a really scientific view of the subject to his readers, he commences with a general sketch of the facts of physical geography as bearing upon the natural and cultivated productions of different countries, indicating the effects of climate and other natural causes upon the nature of these productions, and briefly noticing the chief forms of produce which commerce derives from each country. The second part is devoted to the commercial products of the vegetable kingdom, the third to those derived from the animal kingdom; and the fourth treats of mineral products. Under each of these heads the subjects are arranged in accordance with the uses to which they are put; and in each case the sources of the different commercial substances are indicated, and their commercial statistics are given, generally, as far as this country is concerned, up to the year 1867. As a general rule, these articles are very accurate; but here and there, as perhaps was unavoidable in a first attempt like this, small errors have crept in. Thus, for example, under the head of "furs," we are told that furs are obtained from all the orders of Mammalia except the Bimana and Cetacea. Apart from the fact that all the skins enumerated by the author are not furs in the true sense of the term, the Pachyderms certainly furnish us with nothing that can be denominated a fur: an elephant-muff or a rhinoceros-tippet would be rather a striking novelty. Again, under the same head, there is an important omission: the only seals noticed are the northern species, and the true fur-seals are entirely unnoticed. The account of the natural history of the hive-bee is not quite what it should be, and might be considerably improved without adding to the space it occupies; and the description of the commercial products of the lac-insect is confused, and does not clearly indicate that the dye is the produce of the insect itself, whilst the shell-lac is an exudation from the tree.

Apart from the few inaccuracies above alluded to (the most important one that we have noticed being the omission of the fur-seals), Dr. Yeats's little manual is deserving of great praise; and we hope that it may meet with a success which will speedily enable him to supply its few deficiencies in a second edition.

The vocabulary given in the appendix includes the equivalents of the names of the chief raw products and of the plants and animals producing them, in nearly all the European and in some oriental languages; it may prove useful to others besides those for whose special behoof this book was written.

We should add that this is the first of a series of three works on the same subject, of which one will be devoted to the industrial and political history of commerce, and the second to the technical history of the same subject.

MISCELLANEOUS.

On Astarte excurrens *and* A. modesta.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—In the paper upon the Mediferranean Mollusca, by Mr. Jeffreys, published in your Magazine for July of the present year, reference is made to a few species belonging to the Crag, which up to the present time have been considered extinct, but which are there inserted as still living.

I wish particularly to notice one of these now, as my Supplement to the Crag Mollusca (in preparation) cannot be made to appear before the Palæontographical Society's volume for next year. The one I specially refer to is called *Astarte modesta* of H. Adams (Proc. Zool. Soc. 1869, pl. 19. f. 14); and it is there said to be "allied to *Astarte excurrens* of Searles Wood, and possibly the same species." The recent shell has been placed by Mr. H. Adams as *Gouldia* of C. B. Adams. I have written to Mr. H. Adams for his opinion, and sent to him some Crag specimens of *Astarte excurrens* for comparison. In reply he tells me that he considers the recent and fossil shells to be quite distinct. I have also applied to Mr. M'Andrew, who possesses the recent shell in question, which he obtained in the Bay of Tunis; and he has obligingly sent to me his specimens for examination.

I have now no hesitation in saying that the recent shell (*modesta*) is not only specifically distinct from the Crag one, but that it does not belong to the same genus. My Crag shell has an *external* ligament, and the ridges upon the exterior are not concentric, but oblique, running out at the margin from each side in a curving direction; while the so-called *Astarte modesta* has an *internal* ligament and concentric ridges (*i. e.* ridges parallel to the margin), and belongs to the triangular section of *Crassatella* of which C. B. Adams has made the genus *Gouldia*.

I remain, Gentlemen, yours, &c.,

Brentwood, Oct. 1870. Searles V. Wood.

Helix personata, *Lamarck*.

The tale of British land and freshwater shells is not yet told.

A dead specimen of *Helix personata* has been found by Mr. S. A. Stewart, of Glasgow, at Newcastle, in co. Down; and it is now, through his kindness, in my possession. Last year I examined Mr. Stewart's collection of fossil shells from the Post-Tertiary beds at Belfast and in that neighbourhood; and I have since received several communications from him on the same subject. Judging from his accuracy in these matters, I have every reason to believe that *H. personata* is a native of Ireland, and that his specimen was not accidentally introduced, as was the specimen of *H. aperta* into the Channel Isles.

H. personata inhabits North and South Germany, the Catalonian Pyrenees, the south-east of France, Savoy, Switzerland, Lombardy,

and Dalmatia. I found it under stones and among herbage in the valley of St. Nicholas, on the way to Zermatt. This species belongs to the section or subgenus *Triodopsis* of Rafinesque, *Isogonostoma* of Fitzinger, *Gonostoma* of Held, and *Anchistoma* of H. & A. Adams.

J. GWYN JEFFREYS.

Notice of the Falanaka of Madagascar (Eupleres Goudotii ?). By Dr. J. E. GRAY, F.R.S. &c.

The British Museum has lately received from Madagascar an animal under the name Falanaka, which is new to our collection. It is most likely the "Falanouc" of Flacourt, described from a young specimen, about 16 inches long, which M. Goudot obtained in Tamatave and gave to the Museum of Paris, and which M. Doyère described in the 'Annales des Sciences Naturelles' under the name of *Eupleres Goudotii* (vol. iv. p. 281, tab. viii.).

It agrees with the description in most particulars, except that it has no indication of a black streak across the shoulders. But I suppose that, as the animal was figured from a specimen in spirit, the band was produced by the skin being folded there so that the dark tips of the hairs were all clustered together in this part, as is often the case. The young skull of this animal is described and figured in the same paper, and also in Blainville's 'Ostéogr.' *Viverra*, tab. viii., x., & xii.

The adult animal may be thus described:—Head elongate, nose very much produced, elongate, conical, acute, rounded below, with a very narrow central nick beneath the nostrils; whiskers slender, moderately long; muzzle bald, cartilaginous; nostrils open on the side; lower jaw narrow in front; ears rounded, hairy on the outside; body elongate, rather slender, closely covered with hair; fur olive, minutely punctulated with yellow; the hairs dark at the ends, with two or three very narrow yellow bands; cheeks, temples, chin, throat, belly, and inner side of limbs pale brownish white; underside of the base of the tail rather paler than the upperside; legs moderate, of equal length; soles of the feet with six pads, one central; toes 5.5, united in the skin to the claws; claws of four front toes elongated, arched, compressed, that of the inner toe shorter; claws of the hind feet short, that of the inner toe abortive; the hinder side of the tarsus broad, rather concave, hairy; the tail (not quite complete) is rather shorter than the body, cylindrical, truncate, covered with abundance of hair, which is rather longer than that on the back.

Length of body 22 inches, of tail $10\frac{1}{2}$ inches.

M. Doyère regards the *Eupleres* as forming a distinct family, called the *Eupleriens*, of the Digitigrade Insectivora. Blainville referred it, in his last work, to the genus *Viverra*. I think that the right place is probably in the tribe *Crossarchina* of the family *Rhinogalidæ*, where I placed the genus in the Cat. of Carnivorous Mammalia in the British Museum, p. 176.

On some new and little-known Myriopoda *from the Southern Alleghanies.* By E. D. Cope.

Petaserpes, Cope.

Head concealed to the bases of the antennæ by the shield-like expansion of the scutum of the first annulus. Ocelli two, beneath the margin of the same, and at the approximated bases of the antennæ; the latter large, stout, hairy, six-jointed. Annuli without lateral processes, each with two pores, forming two rows on each side of the body.

Petaserpes rosalbus, Cope.

The segments of the body are flattened below, and gently convex above; their lateral expansion is a little greater than the length of the extended feet; each has a delicate impressed line near the posterior margin, which passes round the extremity, producing the semblance of a longitudinal angle. The extremital margins are entirely continuous. The transverse diameter contracts very rapidly at both extremities, and the anal annulus and head are relatively exceedingly small. The basilar segment is semidiscoid, and forms the segment of a hollow sphere. The anterior aspect is horizontal, and has a delicate marginal rim. The head is inferior, and has the short conic form of *Octoglena*, Wood. The mouth is situated near the extremity of a cone, and not of a rather flattened muzzle as in the Andrognathidæ; there are hairs scattered about it and the sides of the head. The antennæ are of remarkable size for the head, and originate near together, just at the inferior margin of the basilar segment. Just within and above them, at their base, is situated on each side a short crescentic ocellus or aggregate of ocelli, whose superior extremity is concealed by the margin of the basilar segment. In one specimen each of these presents a rugose surface, and in another seems to be divided into four ocelli, perhaps by the accumulation of a light-coloured deposit between the elevations. The antennæ possess six joints, of which the antepenultimate is a little the shortest; they become successively stouter towards the extremity of the antenna, and are all quite hairy.

The reproductive organ of the male is a subglobular body on a short pedicel, hairy except the convex extremity, which is smooth. On the inner side two short pedicels support each a short curved spine, one curved backwards and another forwards.

The annuli are smooth. The anal annulus is small, and for the greater part overroofed by the penultimate, which is broader than usual. The legs are minutely hairy.

The colour of this animal in life is a delicate rose-colour, whitish at one extremity and shading into orange at the other.

The number of the annuli in the adults I find to be fifty-three down to fifty-one. In specimens a little smaller there are forty-six and forty-four; and in the smallest and palest-coloured, hence younger, the number ranges from forty-three to thirty-nine.

The locality whence I obtained this species is on the western

slope of the Cumberland Mountains, in the northern part of East Tennessee. I found them under masses of chestnut-bark in two places, in small families of some size, with *Polydesmus*. They have the motions of *Polydesmi*; *i. e.* they progress slowly, and roll themselves up when captured.

This form is near Wood's *Octoglena*, of which one species (*O. bivirgata*) was found in Northern Georgia. It differs generically in the great extent of the basilar segment, which is very short and leaves the head exposed in *Octoglena*, and in the agglomeration of the ocelli, which in the latter are arranged in two long series of four each.

The annuli appear to be completely chitinized on the median line below.

Observations on other Myriopoda.

Brachycybe Lecontei, Wood, occurs in Jefferson County, in the valley of East Tennesse; it is not very common, and lives under bark of fallen logs. The structure of its head is much like that of *Andrognathus* externally; and the genus is probably to be referred to the Andrognathidæ rather than to the Siphonophoridæ. It differs from the former genus in marked characters, the confluence of the last three articulations of the antennæ being the most important.

Cambala annulata, Say (Cope, Proc. Amer. Philos. Soc. 1869, p. 181), is one of the most abundant of the Myriopoda in the mountain-regions of Tennessee and North Carolina. It is more abundant than *Spirostrephon lactarius*, which it considerably resembles, and with which it is found under bark, &c.

As is known, the Myriopoda of the orders Strongyli and Sugentia are sluggish in their motions, and not furnished with offensive weapons. They therefore produce secretions of a very acrid character, which furnish a secure defence against many enemies. The species of *Spirobolus* and *Julus* discharge a yellowish juice, having much the smell of aqua regia, and a very acrid taste. *Spirostrephon lactarius* exudes, from a series of lateral pores*, a fluid which has in its odour a close resemblance to creosote. *Polydesmus virginiensis* is defended by a fluid which has almost exactly the smell of hydrocyanic acid, and is fatal to small animals. *Petaserpes rosalbus* secretes a considerable quantity of a milky substance which has the perfume of gum camphor.

Pseudotremia cavernarum, Cope, is found in some of the limestone-caves of the valley of Tennessee. I found it especially abundant in the Lost-Creek Cave on the Holston River, in Granger County, near and on piles of bat-excrement, and under stones. In company with it were numerous small, leaping, Lepismoid insects, a Pselaphid beetle, a Carabid somewhat like *Patrobus*, and a spider. Large numbers of a very small *Ixodes*-like animal covered parts of the surface and cavities of the body of a dead bat, in a locality distant from the mouth of the cave.

* I must correct my character "no lateral pores" for *Spirostrephon* (Proc. Amer. Phil. Soc. 1869, p. 179) to "one series of pores."

The writer examined the Lost-Creek Cave for a distance, stated to have been measured, of nearly two miles from the mouth; and the statement is probably correct, judging by the time occupied in passing through to the point reached. A creek of a considerable size issues from the cave; near the mouth it is dammed; and a race leads the water for a short distance to a corn-mill on the banks of the Holston River. The water is crossed by the path perhaps five times before it fills up the passage so as to prevent further progress. The passage is wide, dry, and with so few irregularities that a public road might be readily made in it to that point. I could not find any fishes; just outside the mouth a small *Uranidea* is not uncommon. The dam within the cave abounds in dead *Ios*, *Uniones*, &c., said to be carried there by floods of the Holston, but quite as probably the refuse of the meals of Indians. Bones of Indians, turkeys, and game animals are to be found at the mouth of the cave, which is in a bluff some fifty feet above the level of the river. At one side of the entrance a hard limestone deposit contains charcoal, *Uniones*, and *Melaniæ*. The limestone cliff produced abundance of *Asplenium montanum*, *Pellæa atropurpurea*, and a delicate bipinnate *Pteris*.—*From the Trans. Amer. Ent. Soc.* May 1870. Communicated by the Author.

Note on the Black Crocodile of Africa. By Dr. J. E. Gray, F.R.S.

Mr. Moore has kindly sent me a recent specimen of *Halcrosia nigra* from the river Bonny, in West Africa, presented to the British Museum by Dr. Forsyth, of 18 Saxon Street, Liverpool. It is the only fresh and the most adult specimen of the species I have seen, and is nearly 4 feet long. It is interesting as making me more certain that I am correct in identifying it with the "Krocodile noir du Niger" of Adanson.

The whole animal is black both above and below; the belly has a brownish tinge, very slightly and obscurely dotted with white. The nuchal shields are very thick, with an upright outer edge. This animal has been described as a new species by Mr. Andrew Murray and Mr. Cope, and was confounded by Cuvier with the rough-backed alligator (*Caiman trigonatus*) of South America.

Note on Hyperoodon latifrons (*Gray*).

In an essay lately published by Prof. Reinhardt, he figures the skull of this species and the animal and skeleton of a male fœtus of the common *H. rostratus* (Vid. Selsk. Skr. ser. 5. ix. 1, pls. 6 & 7), observing that pl. 6 "represents the skull of a male *H. latifrons* from the Färöer, a perfect skeleton of which, 25 feet long, is contained in the University Museum at Copenhagen. Eschricht believed that *H. latifrons* was established on a very old male of the common *H. rostratus*; but Gray's species must now be regarded as well established."

Note on Testudo chilensis. By Dr. J. E. Gray, F.R.S.

Looking over Dr. Strauch's 'Mémoires' on the geographical distribution of Testudinata, I find that a Chilian tortoise I described in a former Number was known to D'Orbigny (Voyage dans l'Amér. Mér. Rept. 6) and Dr. Burmeister (Reise durch die La Plata-Staaten, ii. 521); but they regarded it as the same as *Testudo sulcata* of Miller, from Africa. They could not have had specimens of that tortoise to compare it with, or they would not have made such a mistake. M. de Meussy (Desc. Géog. et Statist. de la Conféd. Argent. ii. 38) mentions the same tortoise under the name of *Testudo mauritanica*; but it has no similarity to that species.

Observations on some Vegetable Fossils from Victoria. By Dr. Ferdinand von Müller and R. Brough Smyth, F.G.S.

Mr. Smyth stated that the fossils, of which specimens were forwarded by him, were obtained in one of the deep leads at Haddon, near Smythesdale. No leaves have been obtained from the bed, which consists of a greyish-black clay; the fruits and seed-vessels were obtained about 180 feet from the surface, and represent a flora not very dissimilar to that now characterizing some parts of Queensland. The specimens sent include the fruits of a supposed new genus of Coniferæ, described by Dr. von Müller under the name of *Spondylostrobus*. It is most nearly allied to *Solenostrobus*, Bowerbank; but its five valves are not keeled. The columella forms the main body of the fruit; and the seeds are apparently solitary. The species was named *Spondylostrobus Smythii*. The remaining specimens consisted of:—a solitary fruit of a genus of Verbenaceæ; an indehiscent compressed fruit, probably belonging to the proteaceous genus *Helicia*; a nut nearly allied to the preceding; a large, spherical, unilocular, 3-seeded nut with a thick pericarp, perhaps from a Capparideous plant; a 5-valved capsule of an unknown genus; and fruit-valves of three other plants, probably belonging to the Sapindaceæ, and perhaps allied to *Cupania*. One of the last may belong to the Meliaceous genus *Dysoxylon*. Dr. Müller considered that these remains indicate a former flora analogous to that of the existing forest-belt of Eastern Australia.—*Proc. Geol. Soc.* June 22, 1870.

The Female of Bartlett's Spider Monkey (Ateles Bartlettii). By Dr. J. E. Gray, F.R.S. &c.

The British Museum has recently received a Spider Monkey, having all the appearance and coloration of the Spider Monkey which I have described and figured (Proc. Zool. Soc. 1867, p. 992, pl. 47) under the name of *Ateles Bartlettii*. The parts which are bright yellow in the male which I described are, in this female, white or greyish white, the confines of the two colours are not so distinctly marked, and the spots on the forehead and cheek are much smaller and much less distinct. I have therefore little doubt it is the female of the above species.

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[FOURTH SERIES.]

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XLIII.—*Report on the Testaceous Mollusca obtained during a Dredging-Excursion in the Gulf of Suez in the months of February and March* 1869. By ROBERT M'ANDREW*.

IN the course of an excursion in the East, accompanied by my family, in the early months of 1868, I spent a day at Suez, where I was so much struck by the novelty of the species of shells on the shore of the Gulf, so totally different from any I had seen on the coasts of the Mediterranean and Atlantic, that I resolved to return the following year provided with the implements &c. required for investigating the marine fauna, more especially the Mollusca, of the district, which offered so tempting a field for research.

Accordingly, in the month of January last year (1869), having forwarded dredges, rope, and other appliances by merchant-steamer, and having been so fortunate as to enlist Mr. Edward Fielding as a companion, and engaged the assistance of M. Susini, an experienced collector of shells, I proceeded by way of Marseilles to Alexandria. The interval between our arrival and that of the apparatus (about a fortnight) was occupied in a short visit to Cairo, and in coming to a determination, under the advice of our friends in those parts, as to our course of proceeding, of which we had previously been enabled to form no definite plan.

I was lucky in meeting with a dragoman in whom I had full confidence, having made his acquaintance the previous year; and I arranged with him to supply tents, provisions, and all the requirements for encampment in the desert, including a good cook; and at Suez he brought me into contact with boatmen, his compatriots (Maltese), with whom I made terms for the cruise.

* Communicated by the Author, having been read at the Meeting of the British Association held at Liverpool, Sept. 1870.

We sailed from Suez on the 10th of February, our little squadron consisting of three boats, of which the largest (twelve tons burthen) carried our luggage and stores, the second (five tons) was the worker, and a small boat was only used for embarking and disembarking ourselves and effects. The crew, six in number, was composed of four Maltese, a Neapolitan, and an Arab, a native of Tur, who acted as pilot; and I have great pleasure in stating that I found them all uniformly obliging and desirous of assisting in my pursuits. The Arab turned out to be a first-rate diver, and, not having the fear of sharks before his eyes, thought nothing of going down like a frog to the depth of four or five fathoms, to bring up any portable object that had attracted our notice at the bottom.

We worked slowly down the Gulf, keeping to the Arabian side, as the natives there were more to be trusted than the Arabs of the opposite coast, changing our station about every two days, till in about three weeks we reached Tur, which may be called the seaport of the convent of Mount Sinai. Thence we crossed over to the Point of Zeite and the desolate islands situated towards the western side of the Straits of Jûbal, so named from one of them.

After working for a week among these islands, where the fecundity of the sea is as wonderful as the sterility of the adjacent land, we bore away for Ras Mahommed, the extreme point of the peninsula of Mount Sinai, dividing the Gulf of Suez on the one side from that of Akaba on the other. Here terminated our researches with the dredge, as, in consequence of our having got on more slowly than we anticipated, some of our stores were becoming exhausted, and our water putrid—a slight drawback to what had been truly a pleasure-excursion. The climate was all that we could desire.

We encamped four days at Ras Mahommed before embarking on our return, which we then did in earnest, and, as the prevailing winds are from the north-west, thought ourselves fortunate to reach Tur in a week, without stopping to dredge by the way, though we, of course, encamped on shore every night. Sending the collections and spare luggage on by the boats, we proceeded by land, having engaged a sheik from the neighbourhood of Mount Sinai, with twelve camels and as many Arabs, to convey us to Suez, which we reached in seven days, just fifty days after our departure from it.

Now as regards results.

The total number of species of Mollusca I obtained in the Gulf of Suez (not including the Nudibranchiates, of which I preserved a few in spirits) amounts to some 818, of which 619 have been identified or described, the remaining 199 being still undetermined.

In my list of named species will be found about 355 not previously recorded as inhabiting the Red Sea; of these, 53, including 3 genera, are new to science, and have been described by Mr. Henry and Mr. Arthur Adams. Also most of the undetermined species will probably prove to be new, and all of them additions to the Red-Sea fauna.

Prof. Issel, of Genoa, has recently published a work upon the shells of the Red Sea, in which he enumerates 640 species of recent Mollusca as all that are recorded from that district. His list includes about 100 new species described by himself, some of which had been previously figured, but not named or described, by Savigny in the 'Description de l'Egypte.' As he has inserted species upon the faith of various authors, it is probable that there are some inaccuracies in his catalogue, as in the case of *Nassa circumcincta*, which appears to be included on the authority of Reeve. Not only did I not obtain this species in the Gulf of Suez, but I *did* find it in the Mediterranean, on the coast of Syria, in company with *N. gibbosula.*

The extraordinary dissimilarity between the fauna of the Red Sea and of the Mediterranean, which has been frequently remarked, and which appears to be confirmed by further researches on both sides of the isthmus (holding good with respect to the other Invertebrata and fishes as well as the Mollusca), shows that a barrier between the seas must have existed from very remote time; and this is not inconsistent with Prof. Issel's statement that an examination of the geological conditions of the isthmus leads to the conclusion that the two seas were united during the Eocene and Miocene periods.

It is true, as has been observed by the authority I have quoted, that some of the Suez species appear to be so nearly related to their representatives in the Mediterranean and Atlantic that it is easy to suppose that they may have been originally the same and that their distinguishing characters may have been acquired during the series of ages through which they have been separated, though I could hardly admit this with respect to *all* the species quoted by Issel as Mediterranean equivalents. Such species, however, form but a small percentage of the whole; and I am not sure that more remote localities, such as Japan and Australia, do not furnish about as many examples of relationship to the European fauna.

The number of Suez species that are common to Japan, the Philippine Islands, Australia, the Sandwich Islands, &c. is worthy of remark, as showing that the Mollusca of the Pacific and Indian Oceans have a much wider distribution than those of the Atlantic, where the shores of America possess but few

species in common with the coasts of Europe and Africa. The fact of a species having in several instances been obtained from only two localities very remote from each other, such as Suez and Japan, is to be attributed to (while it is a proof of) the very small amount of knowledge we possess of the fauna of the intervening seas.

It is not to be supposed that my present list is any near approach to a complete catalogue of the Mollusca of the Gulf of Suez, much less to that of the Red Sea, to which it forms but a small contribution. Up to the very last we never returned from a day's work without having added several species to our collection, and we might probably have long continued to do so. It is also remarkable in how many instances we obtained only one or two examples of a species.

In addition to the Mollusca, we omitted no opportunity of collecting specimens of other branches of zoology. The Echinodermata, Crustacea, and Corals, together with the soft animals and a few fishes, I presented to the British Museum, with a request that any spare duplicates might be forwarded to the public museums of Edinburgh and Liverpool. I have received no particular account of them; but Dr. Günther informs me that among the fishes was a new *Hippocampus*.

The sponges I sent to Dr. Bowerbank, on the express condition that he was to give me a report on them; but this I have not yet received. A small sponge which had casually been put into spirits among the soft animals has been described by Mr. Carter, and made the type of the new genus *Grayella*. It is interesting as showing some affinity to the family of Corals.

Of Cirripedia the only species met with in abundance was *Tetraclita porosa*. I obtained a few specimens of a species of *Acasta*, and a curious *Pœcilasma* attached to spines of a *Cidaris*. Prof. Lovén informs me that it is closely allied to *P. eburnea* of Darwin, which was also found on the spines of an Echinoderm in New Guinea. I think that it may very possibly prove to be identical.

N.B. In the following list the localities quoted which are not within the limits of the Gulf of Suez are those from which the respective species are recorded to have been previously obtained.

Mollusca.

Cephalopoda.

Sepia Savignyi, Blainv. Frequent on the shore from Suez to Ras Mahommed.

—— *Lefevrei*, D'Orb. The same.

PTEROPODA.

Hyalœa longirostris, Desh. Frequent on the shore.
—— *quadridentata*, Lesson. One specimen.

GASTEROPODA.

Murex crassispina, Lam. Frequent in sand at moderate depth. Eastern Seas.

—— (*Chicoreus*) *anguliferus*, Lam. Frequent at low water. Ceylon &c.

—— (——) *corrugatus*, Sow. Shore to 10 fathoms; only young specimens living. North Australia.

—— (——) *ramosus*, Lam. Not rare; shore and shallow water. Eastern seas.

——, six species, undetermined; one specimen of each.

Fusus marmoratus, Ph. Suez, common at low water. Australia (*Jukes*).

—— *polygonoides*, Lam. Tur and Jubal Island, abundant at low water. Eastern Seas.

—— *strigatus*, Ph. Low water; two specimens.

Cassidulus (*Volema*) *paradisiacus*, Rve. Abundant at low-water. Indian Ocean, Ceylon.

Cantharus (*Tritonidea*) *rubiginosus*, var., Rve. Two specimens, Ras Mahommed. Red Sea.

—— (——) *funiculatus*. Not rare; shallow water, Ras Mahommed.

Turris grandis, Gray, small variety. Not rare; 5 f., Jubal Island. Indian and Chinese Seas.

—— *cinguliferus*, Lam. Frequent; 5 f., Jubal Isl. Philippines &c.

—— *abbreviatus*, Rve. Frequent; 5 f., Jubal Island. ,,

—— *moniliferus*, Pease. Not rare; 5 f., Jubal Isl. Sandwich Islands.

—— *brevicaudatus*, Rve. Not rare; 5 f., Jubal Island. Philippines.

—— *violaceus*. Not rare; 10–20 f., sand. New Guinea, Philippines (*Hinds*), &c.

——, sp. One specimen; 5 f., Jubal Island.

—— (*Surcula*) *radula*, Hinds. 5 specimens, small var.; 5–10 f. Straits of Malacca.

Drilla flavidula, Lam. Frequent, dead on shore at Suez. China and Japan.

—— *cagayanensis*, Rve. Not rare; 2–5 f., sand, Tur to Ras Mahommed. Philippines.

—— *crenularis*, Lam. One specimen; 2–5 f., Jubal Island &c. Tranquebar.

—— (*Crassispira*) *tessellata*, Hinds. Rare; 2–5 f., Jubal Island. Straits of Macassar.

—— (*Clavus*) *vidua*, var., Rve. Rare; 2–5 f., Jubal Island. Philippines.

——, two species, undetermined.

Daphnella Cumingii, Powis. One specimen, young; 2–5 f., Jubal Island. Pacific.

Daphnella rissoides, Rve. One specimen; 2–5 f., Jubal Island. Philippines.

——, sp. One specimen; 2–5 f., Jubal Island.

Defrancia rubida, var., Hinds. One specimen; 2–5 f., Straits of Jubal. Philippines, New Guinea, &c.

—— *tritonoides*, Rve. Three specimens, young; 2–5 f., Straits of Jubal. Philippines.

—— *mica*, Ph. Four specimens. Straits of Jubal.

—— *polynesiensis*, Rve. Two specimens; Straits of Jubal. Lord Hood's Island (*Cuming*).

——, twenty-six species, undetermined.

Cythara triticea, Kiener. Not rare. Indian Ocean.

—— *turricula*, Rve. Two specimens. Philippines.

—— *capillacea*, Rve. Five specimens. Philippines.

——, nine species, undetermined.

Mangelia rhomboides, Lam.? (*M. pallida*, Rve.?). Not rare. Philippines.

——, ten species, undetermined.

Tritonium tritonis, Linn. Saw a specimen in hands of fishermen. Eastern seas.

—— *ægrotum*, Rve. One specimen; shore, Ras Mahommed. China.

—— (*Simpulum*) *rubeculum*, Linn. Two specimens, Jubal Island. Philippines &c.

—— (——) *pileare*, Lam.? One specimen, young; Tur. Philippines &c.

—— (——) *aquatilis*, Rve. Two specimens, dead; Ras Mahommed. Philippines &c.

—— (*Gutturinum*) *gallinago*, Rve. Three specimens, dead; Ras Mahommed. Philippines.

—— (——) *trilineatum*. Two specimens, dead; Ras Mahommed. Philippines.

—— (*Epidromus*) *bracteatum*, Hinds. Four specimens, Ras Mahommed. Philippines and Marquesas.

—— (——) *lativaricosum*, Rve. Three specimens, Ras Mahommed.

—— (——) *Sowerbii*, Rve. One specimen, young; Jubal Island. Pacific.

—— (*Lagena*) *cingulatum*, Rve. One specimen, young; Jubal Island. Philippines.

——, two species, undetermined; Ras Mahommed.

Distortio anus, Linn. Shore, dead; frequent at Ras Mahommed and at Jubal Island. Ceylon, Philippines, &c.

Bursa bufonia, Bolten. Shore, dead; not rare at Ras Mahommed. Philippines.

—— (*Lampas*) *hians*, Schum., vars. *a* & *b*. Reefs, rare. Philippines.

—— (——) *affinis*, Brod. Shore, dead; frequent at Ras Mahommed. Pacific Ocean &c.

—— (*Apollon*) *concinna*, Ph. One specimen living, one dead; Ras Mahommed. Red Sea.

—— (——) *pusilla*, Brod. One specimen, dead, at Ras Mahommed. Mauritius, Pacific Islands, Philippines.

Phos roseatus, var., Hinds. Two specimens; 5 f., sand, Jubal Island. Philippines, Moluccas.

Nassa coronula, A. Ad. Frequent; shore to 5 f., Straits of Jubal &c. Philippines.

—— *pullus*, Linn. Not rare; shore to 5 f., Straits of Jubal &c. Philippines.

—— *Rumphii*, Desh. Two specimens, Straits of Jubal &c. Philippines.

—— (*Niotha*) *gemmulata*. Rare, dead; 5 f., Straits of Jubal &c. Philippines.

—— (——) *nodicostata*, A. Ad. One, dead; shore, Straits of Jubal &c. Persian Gulf (*Col. Pelly*), Philippines.

—— (——) *Kieneri*, Desh. Frequent; shore to 5 f., Straits of Jubal &c. Réunion.

—— (——) *densigranata*, A. Ad. One specimen; 5 f., Straits of Jubal. Philippines.

—— (*Uzita*) *pulchella*, A. Ad. Rare; 5 f., Straits of Jubal &c. Cape of Good Hope.

——, two species, undetermined.

Teinostoma, sp. One specimen.

Purpura (*Thalessa*) *echinata*, Blainv. Rare; shallow water, Straits of Jubal. Singapore (*Leschke*).

—— (*Polytropa*) *Quoyi*, Rve. One specimen, Straits of Jubal. New Zealand.

Iopas sertum, Lam. One specimen, young; Ras Mahommed.

—— *situla*, Rve. Not unfrequent; dead on shore, Ras Mahommed. Anaa, Pacific (*Cuming*).

Pentadactylus albolabris, Blainv. Two specimens; shallow water, Ras Mahommed. Philippines &c.

—— *arachnoides*, Lam. Several; shore, dead, Ras Mahommed. Philippines &c.

—— *digitalis*, Lam., var. β. Two specimens, dead; Ras Mahommed. Seychelle Islands.

—— *horridus*, Lam. One specimen, from dealer at Suez. Philippines.

—— (*Sistrum*) *anaxares*, D'Orb. One specimen, dead; Ras Mahommed. Lord Hood's Island, Natal.

—— (——) *dealbatus*, Rve. Several, Ras Mahommed.

—— (——) *chrysostoma*, Desh. Three specimens. Philippines.

—— (——) *ochrostoma*, Rve. One specimen.

—— (——) *fiscillum* & var., Chemn. Not rare; on reefs, Suez to Ras Mahommed. Philippines.

—— (——) *Savignyi*, Desh. Common on reefs, Tur to Ras Mahommed. Red Sea.

—— (——) *tuberculatus*, Blainv. Common on reefs, Tur to Ras Mahommed. Pacific Islands.

—— (——) *spectrum*, Rve. One specimen. Philippines.

—— (——) *asper*, var., Lam. Not rare; shallow water, Straits of Jubal. Philippines.

—— (——), sp. Not rare, Straits of Jubal.

Rapana bulbosa, Solander. Not rare; shore, dead. Eastern seas.

Rhizochilus (*Coralliophila*) *costularis*, Blainv. Shore, dead; rare. Philippines.

—— (——) *galea*, Chemn. Shore, dead; rare. Philippines.

—— (——) *exaratus*, Pease. Rare; shore, Straits of Jubal.

—— (——) *madreporianus*, A. Ad. Frequent on coral. Eastern Seas.

Campulotus (*Magilus*) *antiquus*, Montfort. Common in old Madrepore on the islands. Eastern seas.

Leptoconchus Lamarckii?, Desh. In Madrepore, Ras Mahommed. Mauritius.

Harpa crassa, Ph. Not unfrequent on shore at Ras Mahommed and Jubal Island. Red Sea.

Dactylus inflatus, Lam. On shore at Ras Mahommed. Persian Gulf &c.

Ancilla crassa, Sow. Sand at low water; frequent. Red Sea.

—— *lineolata*, A. Ad. Sand at low water; rare. Red Sea.

—— *ovalis*, Rve. Sand at low water; rare. Red Sea.

—— *striolata*, Sow. Sand at low water; frequent. Red Sea.

Fasciolaria Audouini. Dead on shore, Ras Mahommed. Red Sea.

Latirus turritus, Gmel. (*lineatus*, Lam.). Six specimens. Ras Mahommed. Philippines.

—— (*Plicatella*) *polygonus*, Gmel. Dead; rare, Ras Mahommed. Philippines.

Vasum cornigerum, Linn. Abundant on reefs. Moluccas &c.

Mitra Bovei, Kiener. Frequent, dead on shore at Suez; one living, 5 f., sand, Jubal Island. Red Sea.

—— (*Scabricola*) *pretiosa*, Rve. Six specimens; sand at 5 f., Jubal Island.

—— (——) *pura*, A. Ad. Five specimens; sand at 5 f., Jubal Island. Sandwich Islands.

—— (——), sp. Four specimens; sand at 5 f., Jubal Island.

—— (*Cancilla*) *amœna*, A. Ad. One specimen; sand at 5 f., Jubal Island.

—— (*Chrysame*) *Antonelli*, Dohrn. One specimen.

—— (——) *fragra*, Quoy. One specimen. China, Philippines, Lord Hood's Island.

—— (——) *planilirata*, Rve. One specimen.

—— (——) *Wisemani*?, Dohrn. One specimen. Sandwich Islands.

—— (——) *Pharaonis*, Issel. One specimen.

Volumitra?, sp. One specimen.

Turricula (*Costellaria*?) *osiridis*, Issel. Four specimens, Jubal Island. Has a broad brown or black band.

—— (——) *echinata*, A. Ad. Three specimens.

—— (——) *mucronata*, Swains. One specimen. Sandwich Islands.

—— (——) *pulchella*, Rve.? One specimen. Barbadoes.

—— (——) *nodolyrata*, A. Ad. Two specimens.

—— (——) eleven species, undetermined.

—— (*Pusia*) *fidicula*, Gd. One specimen.

—— (——) *hebræa*, Lam. One specimen.

Turricula (Pusia) pardalis, Küster. Two specimens.
—— (——) *tusa*, Rve. One specimen. Philippines.
—— (——) *glandiformis*, Rve. Five specimens.
—— (——), sp. Two specimens.
Strigatella. Three species, undetermined.
Columbella flavida, Sow. Not rare, Tur and Jubal Island.
—— *pœcila*, Sow. Frequent, Tur; sand, shallow water. Philippines.
—— *spectrum*, Rve. Moderate, Tur; sand. Philippines.
—— *tringa*, Lam. Rare, Jubal Island; 5. f.
—— *turturina*, Lam. Rare, Jubal Island; 5 f. Philippines.
——, three species, undetermined.
—— (*Nitidella*) *minima*, Gask. Abundant in 30–40 f., Straits of Jubal.
—— (——), two species, undetermined.
—— (*Mitrella*) *albina*, Kiener. Rare; 5–10 f., Straits of Jubal. Philippines.
—— (*Atilia*) *conspersa*, Gask. Frequent; 5–10 f., Jubal Island. Philippines.
—— (——) *baculus*, Rve. Rare; 5–10 f., Jubal Island. China.
Engina mendicaria, Lam. Abundant at low water, Jubal Island. Philippines.
Marginella pygmæa, Issel. Sand, shore to 5 f.
—— *Savignyi*, Issel. Sand, shore to 5 f.
—— *suezensis*, Issel. Sand, shore to 5 f.
Erato nana, Duc. One specimen.
Cadium pomum, Linn. Rare, Ras Mahommed. Society and Philippine Islands, &c.
Ringicula acuta, Ph. Not rare; 5–10 f., sand.
Lamellaria, sp. Rare.
Natica asellus, Rve. Not rare; shore, Ras Mahommed. Australia.
—— *marmorata*, H. Ad. *fide* H. Adams. 2–5 f., sand. (Mörch questions the species being identical.) Canary Islands (*R. M.*).
—— *maroccana*, Chemn., several varieties. Frequent; shore to 5 f., sand. Canary Islands, Pacific, &c.
Ruma melanostoma, Lam. Not common; shore, dead, Ras Mahommed. Seychelle Islands.
—— *simiæ*, Chem. Rare; shore, dead, Ras Mahommed. Philippines.
Mamma Cumingiana, Rve. Rare; shore, dead, Ras Mahommed. Philippines.
—— *mamilla*, Lam. Moderate; shore, dead, Ras Mahommed. Philippines.
Naticina Lamarckiana, Récl. Rare; shore, dead, Ras Mahommed.
Semicassis (Casmaria) torquata, Rve., & var. Shore, dead, Ras Mahommed. New Holland.
—— (——) *vibex*, Linn. One specimen; shore, dead, Ras Mahommed. Philippines.
Scala Ferussacci, Audouin. Two specimens.
—— *Jomardi*, Audouin. Seven specimens.

Scala, seven species, undetermined.
Cirsostrema attenuata, Pease. Two specimens. Sandwich Islands.
Acus crenulata, Lam. Not rare. Moluccas and Pacific.
—— *consobrina*, Desh. Not rare. Red Sea.
—— *duplicata*, Lam. Frequent. China, Indian Ocean, E. Africa.
—— *maculata*, Lam. On shore, in bad condition. Philippine and Society Islands, Australia, Moluccas, Persian Gulf, &c.
—— *nimbosa*, Hinds. Two specimens. Red Sea.
—— (*Abretia*) *fictilis*, Hinds. Two specimens. Australia.
Terebra babylonia, Lam. Four specimens. China, Sandwich Islands.
—— *cingulifera*, Lam. One specimen. Philippines, Marquesas.
—— *lima*, Desh. Four specimens. China seas.
—— *ligata*, Hinds. Two specimens. Marquesas.
——, species undetermined. One specimen.
—— (*Myurella*) *affinis*, Gray. Frequent, Jubal Island. Philippines, Seychelle Islands, &c.
—— (——) *columellaris*, Hinds. One specimen, Jubal Isl. Tahiti.
—— (——) *variegata*, Gray. Not rare, Jubal Island. West Africa, California.
Pyramidella gracilis, A. Ad. Rare; 12–20 f., sand. Philippines.
—— *corrugata*, Lam. Moderately rare; 4 f. Mauritius.
—— *mitralis*, A. Ad. Not rare. Four specimens; 4 f. Philippines.
—— *subulata*, A. Ad. Rare; 10–20 f. (rose-colour). Philippines.
Obeliscus pusillus, A. Ad. Rare. Philippines.
—— *sulcatus*, A. Ad. Frequent; 2–5 f. Tahiti.
—— *Kieneri*, Issel. Six specimens; 2–5 f.
—— *tessellatus*, Müll. Not rare; 2–5 f. Island of Masbate.
—— *vitreus*, A. Ad. One specimen. Japan (*A. Ad.*).
Syrnola pulchella, A. Ad. Rare. Japan (*A. Ad.*).
—— *aclis*, A. Ad. Three specimens. Philippines (*Cuming*).
—— *aciculata*, A. Ad. Rare. Philippines and Japan (*A. Ad.*).
—— *lucida*, A. Ad. One specimen, n. sp. (*A. Ad.*).
—— *pupina*, A. Ad. Two specimens. Japan (*A. Ad.*).
—— *subulina*, A. Ad. One specimen. Japan (*A. Ad.*).
Orina pinguicula, A. Ad. One specimen, n. g.
Agatha vitrea, A. Ad. One specimen, n. sp.
Turbonilla bifasciata, A. Ad. Rare. China (*A. Ad.*).
—— *acicularis*, A. Ad. Rare. Philippines (*Cuming*).
—— *metula*, A. Ad. Rare. Japan (*A. Ad.*).
—— *candida*, A. Ad. Rare. Philippines (*Cuming*).
—— *fusca*, A. Ad. Rare. Philippines (*Cuming*).
—— *decussata*, A. Ad. Rare. China Sea (*A. Ad.*).
—— *scitula*, A. Ad. One specimen. China Sea (*A. Ad.*).
—— *modica*, A. Ad. One specimen. Japan (*A. Ad.*).
Mamula Macandreæ. Rare; n. sp., Jubal Island.
——?, sp., young. One specimen.
Chrysalida, two species, undetermined.
Odostomia, five species, undetermined.
Oscilla annulata, A. Ad. Four specimens.
Leucotina modesta, A. Ad. Three specimens.

Monoptygma fulva, A. Ad. Three specimens. Philippines (*Cum.*).
Styloptygma lendix, A. Ad. Four specimens. Japan (*A. Ad.*).
—— *nivea*, A. Ad. One specimen, n. sp.
Myonia casta, A. Ad. Two specimens. China seas (*A. Ad.*).
Eulima acuta, A. Ad. Rare; 20 f. Philippines.
—— *opaca*?, Sow. Rare.
—— *subangulata*, Sow. Rare. Indian Ocean.
——, five species, undetermined.
Leiostraca, sp. Rare.
Styliferina callosa, A. Ad. One specimen, n. sp.
—— *goniocheila*, A. Ad. One specimen. Japan (*A. Ad.*).
Niso candidula (young), A. Ad. One specimen. Philippines.
Cingulina circinata, A. Ad. Two specimens. Japan (*A. Ad.*).
Cerithiopsis clathrata, A. Ad. Rare. Philippines.
—— *bacillum*, Issel. Two specimens.
——, two species, undetermined.
Alaba imbricata, A. Ad. Not rare. Japan (*A. Ad.*).
—— *lucida*, A. Ad. One specimen. Japan (*A. Ad.*).
Diola varia, A. Ad. Frequent. Japan (*A. Ad.*).
—— *suturalis*, A. Ad. One specimen. Philippines (*Cuming*).
—— *succincta*, A. Ad. Three specimens, n. sp.
——?, sp. Two specimens.
Scalenostoma Deshayesii, n. sp. One specimen.
Genus undetermined.
" "
Torinia perspectivuncula, Chemn. Rare; shore. Pacific.
Conus (*Stephanoconus*) *lividus*, Hwass. One specimen; shallow water, Jubal Island. Society and Philippine Islands.
—— (——) *Rüppellii*, Rve. One specimen; shallow water, Jubal Island. Red Sea.
—— (*Puncticulis*) *arenatus*, Hwass. Frequent; shallow water, Jubal Island. Ceylon &c.
—— (*Coronaxis*) *abbreviatus*, Nuttall. One specimen; shallow water, Jubal Island. Sandwich Islands.
—— (——) *fulgetrum*, Sow. One specimen; shallow water, Jubal Island. Red Sea.
—— (——) *pusillus*, Chemn. Frequent; shallow water, Jubal Island. Seychelle Islands.
Dendroconus (*Lithoconus*) *flavidus*, Lam. Four specimens; shallow water, Jubal Island. Society Islands.
—— (——) *tessellatus*, Born. Not rare (small); shallow water, Jubal Island. Ceylon, Mauritius.
—— (——) *virgo*, Linn. One specimen, living; shallow water, Jubal Island. Ceylon &c.
Leptoconus (*Rhizoconus*) *lineatus*. One specimen, living, large; shallow water, Jubal Island. Ceylon, Philippines.
—— (——) *malaccanus*?, Hwass. One specimen, dead; shallow water, Jubal Island. Malacca.
—— (——) *nemocanus*, Hwass. One specimen, living; shallow water, Jubal Island. Pacific, Mauritius.

Leptoconus (*Rhizoconus*) *sumatrensis*, Lam. Two specimens, living; shallow water, Jubal Island. Sumatra.

—— (*Chelyconus*) *Adansoni*, Lam. Three specimens; shallow water, Jubal Island. Australia.

—— (——) *erythrœensis*, Beck. One specimen, living; shallow water, Jubal Island. Red Sea.

—— (——) *tœniatus*, Hwass. Abundant; low water, Gaysoom Island. China seas.

Cylinder vicarius. Shore, dead; not rare, Tur. Mauritius.

Hermes nussatella. Shore, dead; not rare, Jubal Island. Society and Philippine Islands.

Strombus (*Monodactylus*) *tricornis*, Mart. Low water; frequent at Suez. Philippines, West Indies?

—— (*Gallinula*) *deformis*, Gray. Three specimens, dead; Jubal Island. Australia.

—— (*Canarium*) *elegans*, Sow. Six specimens; 3–10 f., Jubal Island. Philippines.

—— (——) *fasciatus*, Born. One specimen, living, Jubal Island dead on shore at Suez &c. Red Sea.

—— (——) *gibberulus*, Linn. Very abundant on reefs at Ras Mahommed. Philippine and Society Islands.

—— (——) *fusiformis*, Sow. Three specimens, Jubal Island. North Australia.

—— (——) *Rüppellii*, Rve. Two specimens, Jubal Isl. Red Sea.

—— (——) *terebellatus*, Sow. Two specim., Jubal Isl. Philippines.

—— (——) *floridus*, Lam. Frequent, Jubal Island. Philippines.

Harpago (*Heptadactylus*) *Sebœ*, Valenciennes. Not rare at 4 f., Tur and Jubal Island. Society Islands.

Gladius magnus. Not rare; dead on shore. Red Sea.

Terebellum subulatum, Lam. Four specimens; 12 f., sand, Straits of Jubal. China and Sooloo archipelago (*Ad.*).

Cyprœa fimbriata, Gmel. Abundant on shore, dead; Zeite Point. Japan.

—— *carneola*, Lam. Not rare; reefs, Tur &c. Pacific Ocean.

—— *talpa*, Linn. Not rare, dead. Eastern seas.

—— *erythrœensis*, Beck. One specimen, dead; Zeite Point. Red Sea.

—— *Isabella*, Linn. One specimen, in good condition; Zeite Point. Mauritius.

—— *Macandrœi*, Sow., n. sp. One specimen, in good condition; Zeite Point.

Aricia reticulata, Martyn. Frequent, from fishermen. Eastern seas.

—— *annulus*, Linn. Shore. Eastern seas.

—— *moneta*, Linn. Shore, dead. Pacific Ocean.

Luponia caurica, Linn. Not rare; from fishermen, Tur. Eastern seas.

—— *erosa*, Linn. Not rare; from fishermen, Tur. Ceylon, Mauritius.

—— *lentiginosa*, Gray. One specimen, dead; 4 f., Jubal Island. Ceylon.

—— *lynx*, Linn. Frequent, from fishermen. Pacific Islands, Ceylon, Mauritius.

—— *pantherina*, Solander. Frequent, from fishermen. Red Sea.

Luponia turdus, Linn. Frequent, from fishermen.
Trivia oryza, Lam. Shore, rare; Straits of Jubal. Philippines.
—— *tremeza*, Duclos. Shore; two specimens. Ras Mahommed. West Indies, Sandwich Islands.
—— (*Pustularia*) *nucleus*. Two specimens, Jubal Island.
—— (*Epona*) *cicercula*, Gmel. On shore, in bad condition. Pacific.
Amphiperas, sp. Rare; 8 f., on coral.
Cerithium adenense, var., Sow. Five to ten f.; not rare. Persian Gulf (*Col. Pelly*).
—— *cæruleum*, Sow. Low water; frequent. Red Sea.
—— *bifasciatum*, Sow. Low water, dead; five specimens. Philippines.
—— *gracile*, Pease. Low water, dead; two specimens.
—— *dialeucum*, Ph. Shallow water; rare. Philippines.
—— *erythræense*, Lam. Low water; frequent. Red Sea.
—— *granulatum*, Forsk. Low water; moderate. Red Sea.
—— *lacteum*, Kiener. Shore, dead; rare. Philippines.
—— *morum*, Lam. Shore; one specimen. Madagascar.
—— *rarimaculatum*, Sow. Shore, dead; rare. Philippines.
—— *rostratum*, Sow. Six f.; rare. Philippines.
—— *rugosum*, Wood. Shallow water; moderate. Philippines.
—— *Rüppellii*, Ph. Shore and shallow water; abundant. Red Sea.
—— *scabridum*, Ph. Shallow water; moderate. Red Sea.
—— *echinatum*, Sow. Shore, dead; one specimen. Society Islds.
—— *tuberculatum*, var., Linn. Shore, dead; moderate. Philippines.
—— *turriculum*, Sow. Rare; 5 f. Philippines.
—— *columna*, Sow. Shore and shallow water, several varieties; not rare, Ras Mahommed &c. Philippines.
—— *interstriatum*, Sow. Shallow water; rare.
—— *petrosum*, Wood? }
—— *moniliferum*, Dufresne? } Frequent; low water. Philippines.
—— *variegatum*, Quoy. Shallow water, rare. Philippines.
—— *spathuliferum*, Sow. Five f.; rare.
——, three species, undetermined.
Vertagus fasciatus, Brug. Two specimens, living; 6 f., Jubal Island. Philippines.
—— *Kochi*, Ph. Frequent; 4–6 f., Jubal Island. East Africa.
—— *recurvus*, Sow. Frequent; 5–10 f., Jubal Island.
——, sp. One specimen.
Colina contracta, Sow. Shore; rare.
Bittium tenue, Sow. Shore; one specimen. Port Lincoln.
Triphoris corrugata, Hinds. Rare; 10–30 f. China.
—— *micans*, Hinds. One specimen; 10–30 f. New Guinea.
—— *ornata*, Desh. Not rare; 10–30 f. West Indies.
—— *rubra*, Hinds. Rare; 10–30 f. Sandwich Islands, N. Ireland.
—— *granulata*, Ad. & Rve. Not rare; 10–30 f. China Sea.
——, two species, undetermined.
Cerithidea (*Pirenella*) *Caillaudi*, Potiez & Mich. Abundant on shore. Red Sea.
—— (——), sp. Abundant on shore.

Littorina (*Melaraphe*) *intermedia*, Ph. Low water, rare; Ras Mahommed &c. New Holland, Philippines, Tahiti.

Tectarius millegranus, Ph. Between tide-marks, rare; Ras Mahommed. Red Sea.

—— *subnodosus*, Ph. Between tide-marks, abundant; Ras Mahommed &c. Red Sea.

Modulus candidus, Petit. Rare; one specimen, living, on coral, 4 f. Sandwich Islands.

Risella Sismondi, Issel. Frequent, shore.

Fossarus trochlearis, A. Ad. Shore; one specimen. Eastern Seas (Pegu, Burmah).

Planaxis breviculus, Desh. Low water; frequent.

—— *Savignyi*, Desh. Low water; frequent.

—— *succincta*, A. Ad. Low water; rare, dead.

—— *grisea*, Lam. Low water; frequent.

Ceratia pyrgula, A. Ad., n. sp. Two specimens.

Rissoina clathrata, A. Ad. Two specimens; shore, Zeite Point. Australia, Philippines.

—— *spirata*, Sow. Frequent; shore, Zeite Point and Tur. Australia, Philippines.

—— *tridentata*, Mich. Frequent; shore, Zeite Point and Tur. Philippines, Mauritius, Sandwich Islands.

—— *scalariformis*, C. B. Ad. Not rare; shore, Zeite Point and Tur.

—— *Bertheloti*, Audouin. Not rare; Zeite Point and Tur.

—— *erythræa*, Ph. One specimen.

——, three species, undetermined.

Hydrobia?, six species, undetermined.

Hyala nitida, A. Ad., n. sp.

—— *concinna*, A. Ad., n. sp.

—— *plumula*; A. Ad. Japan.

Microstelma concinna, A. Ad., I suspect to have been described from a worn and broken specimen of *Rissoina spirata*.

Corena tuberculifera, A. Ad., n. g. One specimen.

Rissoa gracilis, A. Ad., n. sp. One specimen.

——, sp. One specimen.

Onobia mirifera, A. Ad. Four specimens. Japan.

Fenella pupoides, A. Ad. Frequent. Japan (*A. Ad.*).

—— *scabra*, A. Ad. Frequent. Japan (*A. Ad.*).

—— *reticulata*, A. Ad. Frequent. Japan (*A. Ad.*).

—— *rufocincta*, A. Ad. One specimen. Japan (*A. Ad.*).

Turritella torulosa, Kiener. Not rare in 12–20 f.

—— *flammulata*, Kiener. Two specimens, in bad condition. Red Sea.

——, four species, undetermined.

Cæcum, sp. Two specimens.

Vermetus eruca, Lam. Frequent.

Xenophora solarioides, Rve. Few specims. in 12 f., sand. Philippines.

Calyptra dormitoria, Rve. Two specimens; shore. Philippines.

——, sp. Three specimens; shore.

Conchlolepas granulosa, A. Ad. One specimen.

Amalthea australis, Quoy & Gaim. Shore to 5 f.; not unfrequent on shells. Australia.

—— *conica*, Schumacher. Two specimens.

Vanikoro rugata, A. Ad. Not unfrequent on shore, Zeite Point, Tur, &c. Réunion.

——, sp. Not unfrequent on shore, Zeite Point.

Neritopsis radula, Linn. Five specimens, on shore; dead. Philippines.

Nerita Rumphii, Récluz. Not rare; low water. Philippines.

—— (*Pila*) *quadricolor*, Chemn. Low water. Red Sea.

—— (*Theliostyla*) *marmorata*, Récluz. Low water; frequent.

—— (——) *sanguinolenta*, Menke. Low water; not rare.

Smaragdia (*Vitta*) *Feuilleti*, Audouin. Shore to 25 f.; frequent.

—— (——), sp. Not unfrequent; 20–30 f.

Eutropia Brongniarti, Audouin. Shore; not unfrequent.

—— *lineolata*, Wood. Not unfrequent; 2–6 f. Mauritius.

—— *variegata*, Lam. 2–6 f.; frequent. Australia.

—— (*Tricolia*) *splendida*. 2–6 f.; rare. Red Sea.

Turbo petholatus, Linn. Shore, dead, Ras Mahommed. Philippines.

—— *Reeveii*, Ph.? One specim., small; shore, dead, Ras Mahommed.

—— *pustulatus*, Brocchi. Two specimens; shore, dead.

—— *arsinoënsis*, Issel. One specimen; shore.

——, sp. Three specimens, one living; 5 f.

Senectus Chemnitzianus, Rve. Low water; abundant. Red Sea.

——, two species, undetermined.

Collonia armillata, A. Ad. Not frequent. Australia.

Liotia, sp. Ten specimens.

Cyclostrema cingulifera, A. Ad. Nine specimens.

——, two species, undetermined.

Genus undetermined. One specimen.

Morchia obvoluta, A. Ad. Two specimens. Japan.

Umbonium roseum, Lam. One specimen, dead. Indian seas, Persian Gulf.

Isanda Emprichii, Issel. Frequent, on shore &c.

Ethalia, sp. Not rare; 10–20 f.

Cardinalia virgata, Gmel. Shore; not frequent. East Indies.

Tectus dentatus, Forsk. Low water; abundant. Red Sea.

Polydonta (*infundibulum*) *erythræa*, Broc. Abundant; low water.

—— (——), sp. One specimen.

Clanculus Pharaonis, Linn. Shore, dead, Zeite Point &c. Red Sea.

——, sp. Frequent, with varieties; shallow water.

Monodonta dama, Ph. Low water; abundant. Red Sea.

Euchelus foveolatus, A. Ad. Rare; 8–10 f.

—— *exasperatus*, A. Ad. One specimen.

—— (*Perrinea*) *stellata*, A. Ad. Rare; 8–10 f.

Thalotia obscura, var., Wood. Not rare; 2–5 f. Natal.

Ziziphinus fagum, Ph. One specimen. Australia.

——, sp. One specimen.

Margarita, two species, undetermined.

Gibbula, two species, undetermined.

Solariella scalariformis, Sow.

Forskalia declivis, Forsk. Frequent; shallow water. Red Sea.
——, sp. On shore.
Stomatia duplicata, Sow. Rare; living in 8–10 f. Philippines.
—— *phymotis*, Helb. Frequent on shore, dead; living in 5 f. Philippines.
Stomatella arabica, A. Ad. One specimen.
——, two species undetermined.
Gena lutea, Lam. Not unfrequent. Eastern seas.
—— *nigra*, Quoy & Gaim. Two specimens. Sandwich Islands.
—— *varia*, A. Ad. Few specimens. Philippines.
Haliotis scutulum, Rve. Not unfrequent on shore; dead.
Lucapina Rüppellii, Sow. Shore; frequent. Red Sea.
——, sp. Low water; frequent.
Macrochisma megatrema, A. Ad. Rare; shore, dead.
Cemoria, sp. One specimen.
Rimula exquisita, A. Ad. One specimen. Philippines.
Emarginula incisura, A. Ad. One specimen.
—— *Cuvieri*, Audouin. Three specimens, dead.
——, three species, undetermined.
Nesta candida, H. Ad., n. g. One specimen.
Hematoma panhiensis, Quoy & Gaim. Shore; several varieties. Philippines.
——?, sp. One specimen; living on coral, Jubal Island.
——, sp. One specimen; dead.
Scutus granulatus, Brug. Rare; dead, Ras Mahommed. Philippines.
—— (*Tugali*), sp. Two specimens; dead.
Dentalium Belcheri, Sow. Not rare; 10 to 30 f. East-India Islands.
—— *bisexangulatum*, Sow. One specimen. Java.
—— *longitrorsum*. One specimen; 20 f. Philippines.
——, eight species, undetermined.
Cadulus gadus. Not unfrequent; 20–30 f.
——, sp. Rare; 20–30 f.
Scutellina cancellata, Pease. Three specimens; dead.
Patella rota, Chemn. Frequent between high and low water. Mozambique.
—— *biradiata*, Rve. Rare, between high and low water. China Sea.
——, five species, undetermined.
Lophyrus affinis, Issel. Frequent; several varieties.
Acanthopleurus spiniger, Sow. Frequent (*teste Carpenter*). Pacific and Philippine Islands.
Tonicia suezensis, Rve. Not frequent.
Acanthochites coarctatus, Sow. One specimen. Philippines.
—— *scutiger*, Ad. & Rve. Rare.
Buccinulus coccinatus, Rve. Rare; five specimens. New Guinea.
—— *suturalis*, A. Ad. Three specimens.
—— *tessellatus*, A. Ad. Ten specimens. Red Sea.
Hydatina physis, var., Linn. Three specimens. Mauritius.
Cylichna decussata, A. Ad. Not common. China Sea.
—— *Villersii*, Audouin. Not common.

Cylichna biplicata, A. Ad. Four specimens. China Sea.
——, sp. Frequent.
—— *pulvisculus*, Ehrenberg. Frequent.
—— (*Menestia*) *bizona*, A. Ad. Rare. China Sea.
Tornatina olivæformis, Issel. Not rare.
——, five species, undetermined.
Volvula acuminata, Brug. Two specimens. Britain, European Seas.
Bulla ampulla, Linn. Shore; not common in good condition. Philippines.
Haminea tenera, A. Ad. Three specimens.
—— *vitrea*, A. Ad. Five specimens. Philippines.
——, sp. Not rare.
Atys alicula, A. Ad. Abundant; living in 5–20 f. Red Sea.
—— *Ehrenbergi*, Issel. Shore; dead.
—— *naucum*, var., Linn. Dead. Borneo.
—— *succisa*, Ehrenb. Dead. Red Sea.
—— (*Dinia*) *dentifera*, A. Ad. Dead. Lord Hood's Island.
——, two species, undetermined.
Philine Vaillanti, Issel. Common on shore; living in 3–5 f.
——, sp. One specimen, with gizzard.
Smaragdinella, sp. Two specimens, dead.
Ianthina bifida?, Nuttall. Shore; dead. Pacific Ocean.
Melampus, sp. Shore; dead.
Marinula (*Monica*), four species, undetermined.
Plecotrema, two species, undetermined. Shore, Suez.
Siphonaria kurrachensis, Rve. Between high and low water; abundant. Kurrachee.
——, two species, undetermined. Ras Mahommed.

CONCHIFERA.

Barnea erythræa, Gray. One valve, Suez.
Teredo (*Uperotis*) *pupina*, Desh. Shore &c., on shells; rare.
Rocellaria Retzii, Desh. One specimen. Réunion.
—— *Rüppellii*, Desh. Frequent.
Brechites (*Aspergillum*) *vaginiferum*, Lam. Shore; broken. Red Sea.
Solen aspersus, Dunk. Two specimens, young; 10 f. Japan.
—— *carneus*, Lam. 10 f. Philippines.
Cultellus marmoratus?, Dunk. Rare; 10 f.
——, sp. A fragment.
Macha (*Azor*) *coarctata*, Gml. Rare; 10 f. Britain, Med., &c.
Corbula sulculosa, H. Ad., n. sp. Frequent; 20–40 f.
—— *erythræa*, H. Ad., n. sp. Rare; 20–40 f.
Sphænia Rüppellii, A. Ad. Three and a half specimens, in coral.
Cryptomya decurtata, A. Ad. One valve. Philippines.
Anatina subrostrata, Lam. Shore; not rare.
Eucharis angulata, H. Ad. One valve; n. sp.
Neæra (*Cardiomya*) *pulchella*, H. Ad., n. sp. Rare; 10–30 f.
Trigonella achatina, Chem. Rare; 10 f. Philippines.
—— *olorina*, Ph. Frequent at low water. Red Sea.

Standella (Merope) Solanderi, Gray. Shore, rare; Ras Mahommed. Moluccas.
Asaphis violascens, Forsk. Rare. Red Sea.
Gari dispar, Desh. Rare. Philippines.
—— *elegans*, Desh. Rare. Philippines.
—— *pallida*, Lam. Rare.
Psammotella oblonga, Desh. Common, Suez. Red Sea.
Tellina (Tellinella) exculta, Gould. 6–10 f.; rare; four specimens. Torres Straits.
—— (——) *Listeri*, Hanley. Shore; rare. Senegal.
—— (——) *Pharaonis*, Hanley. Shore; rare. Red Sea.
—— (——) *rugosa*, Born. New California.
—— (——) *Woodii*, Desh.
—— (——) *resecta*, Desh. One valve. N.E. Australia.
—— (——) *venusta*, Desh. Sandwich Islands.
—— (——) *erythrœensis*, H. Ad.
—— (*Mæra*) *silicula*, A. Ad. W. Columbia.
—— (*Arcophagia*) *capsoides*, Lam. Philippines, Australia.
—— (——) *Isseli*, H. Ad., n. sp.
—— (——) *Savignyi*, H. Ad., n. sp.
—— (——) *scobinata*, Linn. Rare; shore. Society and Philippine Islands.
—— (*Peronœa*) *casea*, G. B. Sow. Rare.
—— (——) *nitens*, Desh. One specimen.
—— (——) *producta*, H. Ad., n. sp.
—— (——) *pura*, H. Ad., n. sp.
—— (——) *triradiata*, H. Ad., n. sp.
—— (——) *rosacea*, H. Ad., n. sp.
—— (——) *lactea*, H. Ad., n. sp.
—— (——) *erythrœensis*, H. Ad., n. sp.
—— (*Peronœoderma*) *simplex*, H. Ad., n. sp.
—— (*Angulus*) *pusilla*, H. Ad., n. sp.
—— (——) *vernalis*, Hanley? Rare. Singapore.
—— (*Tellenides*) *ovalis*, Sow. (Valves.) Molucca, Philippines.
Macoma truncata, Jonas. Valves. Manilla.
Tellidora pusilla, H. Ad., n. sp. Rare; = *Gouldia lamellata*, Issel.
Lucinopsis (*Lajonkairia*) *elegans*, H. Ad., n. sp.
Scrobicularia (*Iacra*) *seychellarum*, A. Ad. Rare; 10–20 f. Seychelle Islands.
Semele Macandreœ, H. Ad., n. sp. Rare.
Paphia glabrata, Gmel. Frequent; 2–10 f. Australia.
Ervilia scaliola, Issel. Rare; 15–25 f.
Venus reticulata, Linn. Shore; valves. Philippines, Madagascar.
Chione costellifera, Ad. & Rve. Frequent; 15 f. Philippines.
—— *pulchella*, H. Ad., n. sp. Rare; 15 f.
—— *Römeriana*, Issel. Frequent; 10 f.
Callista florida, Lam. Frequent; 10–20 f.
—— *crocea*?, Desh. Young; one specimen. Philippines.
Circe adenensis, Ph. Two specimens.
—— *arabica*, Chemn. Abundant; several varieties; shore. Red Sea.

Circe corrugata, Chemn. Frequent; 2–5 f. New Holland.
—— *crocea*, Gray. Frequent; 2–10 f.; two varieties. Red Sea.
—— *lentiginosa*, Chem. Frequent; low water. Red Sea.
—— *pulchra*, Desh. Not frequent; low water. Red Sea.
—— *Savignyi*, Jonas, =*pectinata*, var., Lam. Low water. Indian Ocean, Philippines, &c.
—— *semiarata*, Dunk. Two specimens.
—— *sulcata*, Gray. Varieties frequent; 2–10 f. Philippines.
—— *lenticularis*, Desh. Rare; 6 f. Australia.
—— (*Lioconcha*) *castrensis*, Linn. Rare. Indian Ocean.
—— (——) *picta*, Born. Moderately rare; two vars. Philippines.
—— (——) *hebræa*, Lam. Rare. Persian Gulf (*Col. Pelly*).
Dosinia erythrostoma, Rve. = *erythræa*, Römer. } Shore to 5 f.; moderately frequent. Aden.
—— *hepatica*, Ph., and var. Rare; Ras Mahommed. Natal.
—— *variegata*, var., Chemn. Rare; precisely resembling var. from Moluccas. Australia, Philippines, Moluccas.
Clementia Cumingii, Desh. Valves; shore.
Tapes Deshayesii, Hanley. 5 f.; not abundant. Philippines.
—— *textrix*, Chemn. 5 f.; two specimens; young. Indian Ocean, New Holland.
Rupellaria macrophylla, Desh. Four specimens. Philippines.
Coralliophaga coralliophaga, Gmel. One specimen. Philippines.
—— *striolata*, H. Ad., n. sp.
Petricola Hemprichii, Issel. Not frequent in Madrepore. Philippines.
Cardium (*Trachicardium*) *maculosum*, Wood. Rare. W. Columbia.
—— (*Cerastoderma*) *magnum*, Chemn. Valves; on shore. Ceylon, Madagascar, &c.
—— (——) *arabicum*, Issel.
—— (——) *parvum*, H. Ad., n. sp. Not common.
—— (——) *sueziensis*, Issel. Frequent.
—— (——), sp. Not unfrequent.
Lævicardium pectinatum. A fragment.
Papyridea (*Fulvia*) *papyracea*, Chemn. Not common. Philippines.
—— (——) *tenuicostata*, Sow. Not common. New Holland.
Hemicardia (*Fragum*) *carditæformis*, Rve. Rare.
—— (——) *nivalis*, Rve. Not common. Philippines.
—— (*Ctenocardia*) *fornicata*, Sow. 5–20 f.; rare.
—— (——), sp. One specimen; young.
—— (*Lunulicardia*) *auricula*, Forsk. Not common.
—— (——) *subretusa*, Sow. Rare.
Chama cornucopia, Rve. Frequent; reefs.
—— *foliacea*, Quoy? Rare; reefs. Philippines.
—— *reflexa*, Rve. Common; shallow water. N. Australia.
—— *Rüppellii*, Rve. Common; shallow water. Red Sea.
Chametrachæa elongata, Lam. 4 f.; reefs. Philippines.
—— *rudis*, Rve. 4 f.; reefs. Philippines.
Lucina dentifera, Jonas. Rare; 5–20 f. Red Sea.
—— *Fischeriana*, Issel. Common on shore at Suez.
—— *Semperiana*, Issel. Frequent in 5–10 f.

Lucina elegans, H. Ad., n. sp.
—— *concinna*, H. Ad., n. sp.
—— *Fieldingi*, H. Ad., n. sp.
—— (*Cyclas*) *quadrimaculata* ?, D'Orb.
—— (——) *Macandreæ*, H. Ad., n. sp. Valves.
Codakia exasperata, Rve. Shore; valves. Honduras.
—— *interrupta*, Lam. Shore; rare. Torres Straits.
—— *Reevii*, Desh. Not rare. Réunion.
Loripes pila, Rve. Shore.
—— *decussata*, H. Ad., n. sp. Rare.
—— *picta*, H. Ad., n. sp. Rare.
—— *tumida*, Rve. Valves.
Mysia tumida, H. Ad., n. sp. Rare.
Diplodonta Savignyi, Vaillant. Not unfrequent.
Scintilla Oweni, Desh. Under stones, low water. Philippines.
Actinobulus angisulcatus, var., Rve. Rare.
—— *cardioides*, Rve. Rare. Philippines.
—— *elegantulus*, Desh. Rare.
—— *ovalis*, var., Rve. Rare; one valve. Philippines.
—— *variegatus*, Brug. Rare. Indian and Chinese Seas.
Mytilus (*Aulacomya*) *Cumingianus*, Rve. Rare. Panama.
—— (——) *variabilis*, Krauss. Abundant. S. Africa.
Crenella gibba, H. Ad., n. sp.
—— *ornata*, H. Ad., n. sp.
—— (*Modiolaria*) *cœnobita*, Vaillant. Persian Gulf.
—— (——) *Ehrenbergi*, Issel.
—— (——) *viridula*, H. Ad., n. sp.
Perna auriculata, Krauss. Frequent on reefs. S. Africa.
—— *fulgida*, H. Ad., n. sp. One specimen.
—— *glaberrima*, Rve. One specimen, young. Sidney.
—— *setigera*, Dunk., small var. Rare.
—— *rhomboidea*, var., Hanley. One specimen. Gambia.
—— (*Brachydontes*) *subsulcata*, Dunk., small var. Rare. Manilla.
Lithophaga cinnamonea, var., Lam. Philippine and West-Indian Islands.
—— *Hanleyana*, Dk. Frequent. Red Sea.
Vulsella attenuata, Rve. Red Sea.
—— *corollata*, Rve. One specimen. Zanzibar.
—— *crenulata*, Rve. Red Sea.
—— *isocardia*, Rve.
—— *lingua felis*, Rve. Red Sea.
—— *mytilina*, Lam. Frequent. Red Sea.
—— *rugosa*, Lam. Red Sea.
—— *spongiarum*, Lam. Common. Red Sea.
Avicula ala corvi. Rare, on coral; and var. ? Red Sea.
—— *marmorata*, Ph. One specimen.
Margaritifera margaritifera, Lam. Frequent in Straits of Jubal. Indian Ocean, Pacific.
—— *muricata*, Rve. ? Abundant at low water. Philippines.
Isognomon caudatus, Rve.

Isognomon nanus, Gould.
—— *pectinatus*, Rve. Rare.
—— *quadrangularis*, Rve.
—— *rostratus*, Schum. Rare.
Malleus decurtatus, Lam. New Holland.
—— *regula*, Forsk. Philippine Islands.
—— *solitarius*, Rve. One specimen. Pacific.
—— *tigrinus*, Rve. Moluccas.
Crenatula avicularis, Lam. Shore; sponge. Red Sea.
—— *bicostalis*, Lam. Shore. Red Sea.
—— *folium*, Gmel. Shore. Red Sea.
—— *mytiloides*, Lam. Shore. Red Sea.
—— *nigrina*, Lam. Shore. India.
—— *picta*, Gmel. Shore. Red Sea.
Pinna assimilis, Hanley. Shore. Torres Straits.
—— *hystrix*, Hanley. Shore; two specimens. Australia, Amboyna.
—— *Stutchburyi*, Rve. Shore. Australia.
—— (*Atrina*) *saccata*, Linn. Sandwich and Philippine Islands.
Arca navicalaris, Brug. Two specimens; 5 f. China.
—— *arabica*, Forsk. Frequent; shore to 5 f. Red Sea.
Barbatia decussata, Sow. Not rare; 5 f. Philippines, Australia.
—— *parva*, Rve. Rare; 5 f. Pacific Ocean, Persian Gulf.
—— *setigera*, Rve. Frequent; low water. Zanzibar.
—— *striata*, Rve. Frequent; low water, under stones.
—— *trapezina*, Lam. One specimen. Philippines.
——, sp. minute, allied to *B. raridentata*. One specimen.
—— (*Acar*) *plicata*, Chemn. Not unfrequent. Red Sea.
Scapharca pygmæa, H. Ad., n. sp.
Anomalocardia Hankeyana, Rve. Shore; rare. Mozambique.
—— *transversa*, H. Ad., n. sp.
—— *rotundicostata*, Rve. Shore; rare.
Axinea arabica, H. Ad., n. sp. 8–10 f.; frequent.
—— *livida*, Sow. Rare. Réunion.
—— (*Pectunculus*) *pectiniformis*, Lam. Shore; frequent. Philippines.
Limopsis multistriata, Forsk. 5–20 f., mud; abundant.
—— *cancellata*, Rve. Three specimens. Singapore.
Nucula inconspicua, H. Ad., n. sp. 30–40 f.; numerous valves, one living.
Pecten concinnus, Rve. Shore; valves.
—— *lividus*, Lam. Frequent on Madrapore. Persian Gulf.
—— *sanguinolentus*, Rve. One young and a valve; shore. Red Sea.
—— *senatorius*, Gmel. Shore; not frequent. Moluccas &c.
—— *serratus*, Sow. Rare; valves. Philippines, Mauritius.
—— *varius*, Linn. Rare; cannot be distinguished from European specimens. Britain, Mediterranean, &c.
——, sp. A fragment.
—— (*Pallium*) *plica*, Linn. Frequent; 2–6 f. China, Ceylon.
Vola erythræensis, Sow. (*filosa*, Rve.). Not unfrequent. Australia.
Radula paucicostata, Sow. Not unfrequent on Madrepore. Réunion.

Radula inflata, Chemn. Rare; valves. Mediterranean.
—— *tenuis*, H. Ad., n. sp. Rare.
—— (*Ctenoides*) *scabra*, Born, varieties. Rare.
—— (*Limatula*) *pusilla*, H. Ad., n. sp. Rare.
—— (*Mantellum*) *fragilis*, Bolten. Rare. Philippine and Sandwich Islands.
Limæa pectinata, H. Ad. 40 f.; valves; frequent.
Spondylus aculeatus, Chemn. Shallow water, on coral &c. Mauritius.
—— *plurispinosus*, Rve. One valve.
Plicatula philippinarum, Hanley. Philippines.
Pedum spondyloideum, Gmel. In coral. Indian Ocean, Mauritius.
Ostrea (*Lopha*) *cucullata*, Born. Low water, rocks. Philippines.
—— (——) *frons*. Valves. W. Indies.

XLIV.—*Contributions to the Study of the Entomostraca.* By GEORGE STEWARDSON BRADY, C.M.Z.S.

No. V. *Recent Ostracoda from the Gulf of St. Lawrence.*

[Plate XIX.]

THE specimens which form the subject of the present notice have been kindly placed in my hands by Dr. Dawson, of Montreal, for examination and description. They were dredged by Mr. G. M. Dawson in various parts of the Gulf of St. Lawrence, in depths varying mostly from 10 to 50 fathoms, but in one case reaching 250 fathoms. The following is the list of species:—

Argillœcia, sp.
Cythere leioderma, *Norman.*
—— lutea, *Müller.*
—— pellucida, *Baird.*
—— emarginata, *Sars*, sp.
—— concinna, *Jones.*
—— tuberculata, *Sars.*
—— canadensis, nov. sp.
—— villosa, *Sars.*
—— dunelmensis, *Norman*, sp.
—— Dawsoni, nov. sp.
—— abyssicola, *Sars*, sp.
——(?) Whiteii, *Baird*, sp.
—— costata, *Brady.*
Cytheridea papillosa, *Bosquet.*
Cytheridea punctillata, *Brady.*
—— Sorbyana, *Jones.*
—— ? elongata, *Brady.*
Eucythere Argus, *Sars*, sp.
Loxoconcha, sp.
Xestoleberis depressa, *Sars.*
Cytherura undata, *Sars* (var.).
—— pumila, *C., B. & R.* (MS.).
—— ? concentrica, *C., B. & R.* (MS.).
Cytheropteron nodosum, *Brady.*
Bythocythere turgida, *Sars.*
Cytherideis foveolata, nov. sp.
? Philomedes interpuncta, *Baird*, sp.
Bradycinetus, sp.

The determination of these species has been a most perplexing task, owing to their variation in most cases from the types as known to us on this side of the Atlantic. It is probable, indeed, that many which I have here identified with well-known species would by other carcinologists be thought worthy

of distinct specific rank; but, considering the small number of specimens at my disposal for examination, I have thought it better to err, if err I must, by allowing too much latitude to variation, rather than by unnecessary species-splitting. The variation, though in most cases such as to be almost incommunicable by drawings or written description, is nevertheless sufficient to be puzzling, consisting in very slight modifications of the shell in almost all directions—in outline, proportions, and degree of surface-ornament. Such remarks as I have thought it necessary to make on these points will be found under the names of the different species.

It would be unwise to generalize hastily from the small number of dredgings here described; yet we cannot help noticing that the general facies of this fauna much more nearly approaches to that of the Shetland seas or of the Scottish glacial clays than it does to that of England, while it has scarcely any thing in common with that of the Mediterranean. The species which give it an emphatically boreal character are *Cythere leioderma* (perhaps the most abundant species in these dredgings, and hitherto found only in the Shetland seas), *C. emarginata*, *C. costata*, and *Cytheridea Sorbyana*, all of which may be said to range, on our side of the Atlantic, north of the 60th degree of north latitude. And several other members of the list become with us very scarce south of 54°: these are *Cythere concinna*, *C. lutea*, *C. tuberculata*, *C. dunelmensis*, *Cytheridea papillosa*, and *C. punctillata*. Except the three species here described as new, these two lists include all the characteristic species of Dr. Dawson's dredgings, the rest being represented in each case only by one or two specimens, often imperfect.

Argillœcia, sp.

One specimen, possibly referable to *A. cylindrica*, Sars.

Cythere leioderma, Norman. (Pl. XIX. figs. 11–13.)

(Norman, Shetland Dredging Report, p. 291.)

Carapace, as seen from the side, subquadrate, slightly higher in front than behind; greatest height situated at the anterior third, and equal to about half the length; anterior extremity obtuse, obliquely rounded; posterior subtruncate, sinuated in the middle: superior margin scarcely arched, obsoletely angular about the eye-tubercles; inferior nearly straight, with a slight median sinuation. Seen from above, the outline is broadly ovate (almost elliptical), only slightly narrower in front than behind; greatest width equal to the height, and

situated near the middle: extremities broadly and evenly rounded. Hinge-margins somewhat depressed; hinge-processes strongly developed. Surface of the shell smooth and polished, beset with more or less numerous circular punctures, each bearing a short rigid hair. Colour yellowish white. Length $\frac{1}{25}$ inch.

This is the most abundant species in the dredgings here described, and occurs in greater or less quantity in almost all the localities. In Britain it is known only from the single (?) specimen described by Mr. Norman, which was taken in "very deep water" in Unst Haaf. Mr. Norman's description applies accurately to the American specimens, except in the matter of the "distant punctured papillæ." The ornamentation, it is true, does appear papillose in some lights; but this is, I think, an optical illusion: when carefully examined, the seemingly elevated circles resolve themselves into concave pits, each with a little central bristle. I have seen a single fossil valve of this species from the Scottish glacial clay.

Cythere tuberculata, Sars.

These specimens are much less rounded in outline and more rugged in general appearance than is usual with European specimens; there is also a tendency, more or less pronounced, to the formation of one or more longitudinal ridges near the ventral border. But the distinctions do not seem sufficient to warrant the separation of the form as a new species.

Cythere canadensis, nov. sp. (Pl. XIX. figs. 4–6.)

Carapace elongate, compressed; seen from the side, quadrate; greatest height situate at the anterior third, and scarcely equal to half the length; anterior extremity very obliquely rounded, and bordered at the lower angle with several small teeth; posterior subtruncate, slightly emarginate in the middle: superior margin gently sloping, nearly straight, sinuated behind the anterior hinge; inferior margin also straight, excepting a slight median sinuation. Seen from above, somewhat lozenge-shaped, somewhat tapered toward the front, more rounded behind, widest near the middle; width equal to about two-fifths of the length; extremities obtuse, subtruncate. Shell-surface uneven, irregularly pitted, marked with more or less prominent, flexuous, longitudinal ribs, and bearing usually a rounded central tubercle; bordered in front, a little within the anterior margin, by a wide, elevated, and rounded ridge; posterior margin having a similar but less conspicuous border. Length $\frac{1}{35}$ inch.

This species approaches very closely to *C. abyssicola*, Sars, and *C. Stimpsoni*, Brady. From the former it differs chiefly in having a less pronounced marginal belt, a more rugged surface, and a less angular outline when viewed from above; from the latter in the absence of any sharply cut longitudinal crests, and by its more rounded contour and elevated anterior margin. There is, however, considerable diversity amongst the specimens here grouped under the specific name *canadensis*, and it is possible that a more extended series might have shown that they belong to two or more species. The chief difference resides in the surface-ornament, some exhibiting several short, rough and abruptly elevated ridges, others being only moderately pitted, while some (from one of which our drawings are taken) are intermediate in character, being rather delicately ridged, chiefly on the posterior half, and vaguely pitted and ridged in front.

Cythere Dawsoni, nov. sp. (Pl. XIX. figs. 8–10.)

Carapace, seen from the side, quadrangular, highest in front; greatest height equal to half the length; anterior extremity obliquely rounded, bordered with strong blunt teeth; posterior narrower, rectangularly truncate, slightly rounded: superior margin nearly straight, gently sloping backwards, irregularly emarginate; inferior almost straight. Seen from above, subhexagonal; sides nearly parallel, suddenly tapering towards the extremities, which are obtusely mucronate; outline throughout very rugged. Surface marked by irregularly scattered rounded tubercles, and by two irregular longitudinal rows of transversely elongated tubercular eminences. Length $\frac{1}{35}$ inch.

This is apparently a very distinct species; but the single specimen contained in these dredgings was unfortunately lost while the drawings here given were in course of completion; so that I am unable to describe it as accurately as might be wished.

Cytheridea elongata, Brady.

The specimen so named is very doubtfully referred to this species; and the same remark may apply to

Xestoleberis depressa, Sars,

of which only a poor specimen occurs, and may perhaps belong to some other member of the genus.

Cytherura undata, Sars, var. (Pl. XIX. fig. 7.)

A specimen which I suppose to belong to *C. undata* differs enough to make it worth while to figure it. The difference is chiefly in surface-sculpture, but slightly also in outline.

Cytherura pumila, C., B. & R., and *Cytherura concentrica*, C., B. & R.

These species have already been figured and described (in MS.) by the author in conjunction with Messrs. Crosskey and Robertson, from fossil posttertiary specimens; and I have not thought it right here to forestall those descriptions, the publication of which I hope may not be long delayed.

Cytherideis foveolata, nov. sp. (Pl. XIX. figs. 1–3.)

Carapace elongate, compressed; seen from the side, siliquose, slightly depressed in front; greatest height situate about the middle, and equal to rather more than one-third of the length; extremities rounded, the anterior much the narrower: superior margin almost straight, inferior slightly sinuated in the middle. Seen from above, elongate ovate, widest near the middle, tapering gradually toward the front, more abruptly behind; extremities acuminate; width equal to one-third of the length. Shell-surface smooth, minutely and somewhat densely punctate, semitransparent, horny. Length $\frac{1}{35}$ inch.

Nearly allied to *C. subulata*, Brady, but more robust and more densely punctate.

EXPLANATION OF PLATE XIX.

Fig. 1. *Cytherideis foveolata*, carapace, seen from the left side. ⎫
Fig. 2. The same, seen from above. ⎬ ×40.
Fig. 3. The same, seen from below. ⎭
Fig. 4. *Cythere canadensis*, carapace, seen from the left side. ⎫
Fig. 5. The same, seen from above. ⎬ ×50.
Fig. 6. The same, seen from the front. ⎭
Fig. 7. *Cytherura undata*, var., carapace, seen from the left side. ×84.
Fig. 8. *Cythere Dawsoni*, carapace, seen from the left side. ⎫
Fig. 9. The same, seen from above. ⎬ ×50.
Fig. 10. The same, seen from below. ⎭
Fig. 11. *Cythere leioderma*, carapace, seen from the left side. ⎫
Fig. 12. The same, seen from above. ⎬ ×40.
Fig. 13. The same, seen from behind. ⎭

G. S. Brady del. et lith. W. West imp.

XLV.—*Reply to* Dr. Sclater *on the Wart-Hogs.* By Dr. J. E. Gray, F.R.S. &c.

The only reply that I think it desirable to give to Dr. Sclater's observations in the preceding Number, as regards the Wart-hogs, is to request such readers as take sufficient interest in the question to read my two former notes on the subject, which were called forth by Dr. Sclater's remark in the 'Proceedings of the Zoological Society,' and then to read his observations; and I feel sure that they will think them as sophistical and unlike a scientific communication as his paper in the 'Proceedings,' in which he figured a head of an adult male and of a young female, without stating their age or sex, as "illustrative of the external difference between these two wart-hogs" (*P. æthiopicus* and *P. Æliani*). It has yet to be proved that the whole difference between the two heads does not depend upon the age and sex of the animals whose heads are figured. The heads are known to change in form, and very probably the hair on the ears becomes more developed, as the animal reaches the adult age; and it is one of the scientific uses of the Zoological Gardens to observe such facts. And I think it a pity that Dr. Sclater did not wait until he could inform us whether this was the case, more especially as the nakedness of the ears is not the character given by Rüppell of *P. Æliani*; and if it should have been found that when the animal reached the adult age it had such ears as are figured, it would have been the addition of an important fact to our knowledge of the genus, the existence of a second species of which would give me great pleasure.

It is true that the observations of "M. F. Cuvier, Van der Hoeven, and Owen," and I may add Ehrenberg, Sundevall, and others, did not prevent me from uniting the two species, which they wish to establish under different names, in my recent Catalogue, because I have always thought that in natural science the result of examining a number of specimens was more to be relied on and more conducive to the progress of science than deference to the opinion of the most scientific and revered names. In this case I had under my eye more skulls than I believe all the zoologists quoted taken together had the opportunity of examining when they made their observations, which were all made on skulls and their teeth. I examined patiently and repeatedly to discover if I could divide them into two kinds, according to the characters which the naturalists quoted had used to separate the two presumed kinds; and I came to the conclusion that it was impossible to sepa-

rate them by any of those characters, and at the same time proved that the characters proposed were not sexual, but only accidental variations to be found in specimens from the same locality and killed at the same time; and I felt convinced that if any of the authors named had had the opportunity of examining a similar series of skulls, they would have come to the same conclusion as M. de Blainville had come to, from the same cause, in his 'Ostéographie des Mammifères,' where he considers all the skulls those of *P. æthiopicus*. I by no means deny that there may not be two species to be distinguished by external characters; but when I published my Catalogue no such characters had been pointed out, and I have only had the opportunity of examining very few preserved skins or living animals.

If the difference in the ears pointed out by Dr. Sclater proves to be permanent in all ages of the animal, and the peculiarity of a species which has not been before observed, it will be an interesting fact, and will be duly appreciated by me and other zoologists.

I am perfectly aware that I have made many mistakes, in the more than half century that I have been publishing, both of omission and commission; indeed the constant revision to which I have submitted my own papers on zoology show how painfully conscious I am of the fact, and how anxious I am to arrive at the truth. I have written many papers and described many animals, and suggested various alterations in the systematic distribution of them; consequently I am much more likely to commit errors than persons who have only described a few species or confined themselves to the study of a single series of animals.

Lately almost all Dr. Sclater's papers on mammalia have been criticisms on my communications. As soon as these are published, he generally comes to examine the specimens which I have described, consulting at the same time my assistant or attendant on the subject, to all which I can have no objection if they add any thing to the scientific knowledge of the subject; but they often end in the statement of a point I had already examined and not considered worthy of recording, or, from his want of experience in the study of mammalia (for birds have been his chief study), in what I consider a mistake. I am quite willing to leave these questions for future zoologists to decide who was right.

XLVI.—*Mediterranean Mollusca.* No. 2. By J. Gwyn Jeffreys, F.R.S.

Since the publication of my paper on this subject in the 'Annals' for July last I have examined several local collections in Sicily and at Naples; and I shall be glad to correct a few errors which unavoidably occurred in my notice of more than three hundred species.

Brachiopoda.

Platydia Davidsoni.—This certainly belongs to the genus *Megerlia*; and I am inclined to agree with Philippi that it is an abnormal form of *M. truncata*, as, indeed, was suspected by Scacchi, who described it in 1833 under the name of *Terebratula monstruosa.* The lower valve, being attached to coral, is usually flat, although sometimes puckered or indented so as to fit the sinuosities of its *point d'appui*; and consequently the striæ on this valve are wanting. The tubercles, however, are now and then observable on its edges, where the attachment has not been complete. A still greater range of variation, as regards shape and sculpture, is exemplified in *Anomia ephippium.* I cannot detect any essential difference in the skeletons of the typical and monstrous forms of *M. truncata.*

Conchifera.

Pecten Testæ.—With respect to the recorded depth of about 1100 fathoms, I may remark that when I was at Malta Mr. Gibson, the manager there of the Anglo-Indian Submarine Telegraph line, showed me a chart and notes which threw considerable doubt on the accuracy of the information supplied to M. Alphonse Milne-Edwards. It seems that the cable between Cagliari and Bona parted and was taken up in comparatively shallow water only.

Axinus transversus.—*Lucina transversa* of Bronn, fossil in the South-Italian tertiaries, and living on the coasts of Sicily and North Africa, is also a species of *Axinus*, but not *A. flexuosus*, var. *Sarsii.*

Astarte modesta.—Mr. Searles Wood has, in the last number of the 'Annals,' taken exception to my statement that this is allied to his *A. excurrens* and possibly the same species. He is nearly right in his criticism, although I do not admit his inference that this is one of the Crag species hitherto considered extinct but inserted in my list as still living. I have now, through the kindness of Mr. M'Andrew, seen the typical

and perfect specimens of *Gouldia modesta*, and have for the first time observed the cartilage, which is not possessed by any *Astarte*. Mr. Wood has also obligingly allowed me to examine his specimens of *A. excurrens*. Of course no part of the ligament is preserved in the Crag shells. The first-named species, therefore, must be placed in the genus *Crassatella*. *Thetis* (afterwards changed to *Gouldia*) of C. B. Adams is merely a synonym of *Crassatella*. Neither the American nor the English eminent conchologists of the same name noticed the cartilage or internal ligament in their descriptions of *Thetis* and *Gouldia*. *Astarte* and *Crassatella* are closely allied. *C. modesta* and *A. excurrens* have a great resemblance; and, in both, the ridges are (to use Mr. Wood's own words in his description of the latter species) "subconcentric, deviating a little from the lines of growth," so that at least one of the ridges disappears on the anterior side.

Verticordia granulata.—I have now dredged specimens of this species, as well as of *V. acutecostata*, equal in size to those from North Japan.

Gastropoda.

Gadinia Gussonii of Costa, not of Scacchi. *G. excentrica*, Tiberi, is probably distinct.

Emarginula Adriatica.—Read *E. cancellata*. The first-named is a different species.

Hela.—Footnote, for "dread" read "drear."

Pyramidella læviuscula.—The specific name should be that given by Bronn, *plicosa*. See Herr Weinkauff's notices in the 'Bullettino Malacologico Italiano,' vol. iii. p. 97.

Solarium Architæ.—Read *S. fallaciosum*. The former species is flatter, with a rounded periphery, and it has a much larger and more open umbilicus.

Pleurotoma carinata.—Professor Seguenza does not appear to have read what I said in the fifth volume of 'British Conchology' (p. 222) as to the specific name, when he published his article in the third number for this year of the 'Bullettino Malacologico Italiano.'

Pteropoda.

Clio pyramidata.—This and the following two species belong to the genus *Clio*, not *Cavolina*. By a mistake in writing or printing, the letter *C* did duty for both genera.

XLVII.—*Observations on the* Madreporaria *or "Stony Corals" taken, in the late Expedition of the Yacht 'Norna,' off the Coast of Spain and Portugal.* By W. Saville Kent, F.Z.S., F.R.M.S., of the Geological Department, British Museum.

Sect. Aporosa.

Fam. **Turbinolidæ.**

Caryophyllia Smithii, Stokes.

This coral was dredged up attached to shells and stones, at a depth of 20 fathoms, off Cezimbra. Specimens kindly placed in my hands by Mr. Gwyn Jeffreys, from the Hebrides, Valencia, and Malta, convince me of the correctness of Dr. Duncan's opinion that *C. Smithii*, *borealis*, and *clavus* are merely varieties of the same species; but at the same time there are, I think, scarcely sufficient grounds for uniting with these, as he proposes, the Mediterranean *Caryophyllia cyathus.* This latter possesses a massiveness and compactness of its corallum and internal arrangement and structure, and a smoothness of the external surface of the theca, which bestow upon it a facies quite distinct from what obtains in either of the other varieties; the columella, pali, and septa are far more solid, and the latter would also seem to be more rounded and more evenly exsert. In *C. cyathus*, again, the contour of the calicinal fossa is almost or quite circular, while in the other varieties it is usually more or less oblong.

Desmophyllum crista galli, M.-Edw.

Three examples of this species, all of which were attached to masses of *Lophohelia prolifera* or its variety *anthophyllites*, were obtained from a depth of 500 fathoms. As individuals, the three differ from one another considerably. One extreme example has large prominent costæ continuous from the exterior margin of the exsert septa of the primary, secondary, and, often, tertiary orders, to the very base: in the oppositely extreme one the costal elements are entirely absent or merely represented by obscure longitudinal striæ. The intermediate form has the costæ produced superiorly, while towards the base the theca is simply striate. In internal structure and arrangement, including the development of the septa, the three specimens taken agree precisely.

In consideration of the above remarks, it will, I think, be necessary to refer to this same species the *Desmophyllum Rusei* of Michelotti (Mém. sur les Corall. des Antilles, 1859), which

he distinguishes from *D. crista galli* simply on account of its prominent and persistent costæ.

Fam. Oculinidæ.

Lophohelia prolifera, M.-Edw.

Some magnificent examples of this branching coral were brought up, with the assistance of the fishermen's hooks and lines, off Cezimbra, from a depth varying from 400 to 600 fathoms. The whole series is admirably illustrative of the extreme diversity of form this coral is susceptible of assuming under, we may presume, modified external conditions. Dr. P. M. Duncan has already pointed out ('Porcupine'-Expedition Madreporaria, Proc. Roy. Soc. 1870) that the form hitherto considered a distinct species, and described as *Lophohelia anthophyllites*, must now be recognized as a variety only of the type species *L. prolifera*. This variety is very well represented among the examples taken in our recent dredging-cruise; and their study has suggested the following as the interpretation of the causes at work which bring about this particular modification of form. One of the masses now before me exhibits at its base the short wide-mouthed calices with the characteristic exsert primary septa of *Lophohelia prolifera*, while above, and springing from them, are the attenuate and frequently almost cylindrical forms with little-exsert septa, which constitute the leading features of *L. anthophyllites*. On arriving on board our yacht the whole basal portion of this specimen was invested and all the interstices filled up with mud; and this, in connexion with the attenuate or, so to say, *drawn-up* character of the superiorly situated calices, would seem to indicate that at a certain period of its living history a greater deposit of sedimentary matter had taken place in the ocean bed; the coral-colony was consequently threatened with speedy destruction, and in the struggle for existence it had thrown off these longer forms of calices, which would serve to raise it up beyond the action of the untoward conditions then existing. This interpretation is further strengthened by the direction of the calices in the two extreme portions of the mass: in the lower part they all follow an irregular horizontal disposition, while in the upper one they are all directed perpendicularly upwards. The variety of structure in the individual calices of this same specimen is very remarkable. Some have only the primary, and others both the primary and secondary septa much exsert and equally developed, while a third variety has all the septa alike, not at all exsert, and existing as little more than striations on the internal surface

of the calyx. While the contour of the orifices of the calices differs much, some being quite circular or prismatic and others oval, there is quite as much variation in their size, some being over three quarters of an inch in breadth, while the smallest do not exceed one fifth : these last have an attenuate and vermicular appearance, with the rudimentary septal development before alluded to. The character of the costæ is equally variable, being either highly developed or altogether suppressed, with every intermediate condition. The coloration by iron is very conspicuous in some of the older parts of the corallum; and its presence in large quantity has been clearly ascertained by my colleague Mr. Thomas Davies, of the Mineralogical Department.

Amphihelia oculata, M.-Edw.

A single luxuriant example of this common Mediterranean form was taken; but it does not possess any marked peculiarities.

Sect. PERFORATA.

Fam. **Eupsammidæ.**

Dendrophyllia ramea, Blainville.

Fragments of this magnificent arborescent form were observed on various occasions in the houses of the residents at Setubal; but not having heard of examples being taken so far north, I presumed they had been obtained from the Mediterranean, which sea is the headquarters of this coral. Before the yacht's departure, however, the fishermen brought us, freshly taken, with the brilliant orange-coloured polypes scarcely dead, huge masses, two feet in length, having some of the main branches upwards of three inches in thickness.

The depth at which these specimens were taken is stated to have been nearly 100 fathoms. The same statement applies also to the example of *Amphihelia oculata*.

XLVIII.—*Notices of British Fungi.* By the Rev. M. J. BERKELEY, M.A., F.L.S., and C. E. BROOME, Esq., F.L.S.

[Continued from ser. 3. vol. xviii. p. 129.]

1182. *Agaricus* (Lepiota) *metulæspora*, B. & Br. in Ceylon Fungi, ined.

This species, which at present has been found only once in this country by Mr. Broome, and which in external characters

approaches *A. clypeolarius*, is at once distinguished by the length of its spores, which is ·0006 inch *.

1183. *A.* (Lepiota) *Terreii*, n. s. Pileo subhemisphærico rufo pulverulento verrucis minutis exasperato; stipite subæquali squamis furfuraceis concoloribus ornato, annulo demum fragmentitio; lamellis albis, angustis, remotis.

On sandy ground. Forres, Michael Terry, Esq.

Pileus 1–2 inches, bright tawny; scales on the stem of the same colour, often cylindrical; gills not branched. Spores ·0002 inch long by ·00015 wide.

This species, which appears quite distinct, approaches *A. granulosus*, on one side, and *A. acutesquamosus* on the other, but is nearer to the latter than the former. The spores of *A. granulosus* are slightly larger, those of *A. acutesquamosus* are rather longer, and at the same time narrower.

**A.* (Lepiota) *clypeolarius*, Fr. Ep. p. 15.

It is very desirable that the spores of this species and allied forms should be carefully observed, as they seem to be the surest distinction between this species and *A. cristatus*.

1184. *A.* (Lepiota) *ermineus*, Fr. Ep. p. 15.

Coed Coch, Mrs. Lloyd Wynne.

**A.* (Lepiota) *ramentaceus*, Bull. t. 595. f. 3.

Under trees, Coed Coch, sometimes abundantly.

1185. *A.* (Lepiota) *holosericeus*, Fr. Ep. p. 16.

On the soil of flower-beds, Horticultural Gardens, Chiswick.

**A.* (Lepiota) *cepæstipes*, Sow. t. 2.

An extremely beautiful and graceful form of this species occurred in a hothouse at Coed Coch, resembling closely *A. licmophorus*, B. & Br., an unpublished species from Ceylon. The species, however, is confessedly so variable that we do not like to separate it, though far more delicate and more brightly coloured.

1185 *bis*. *A.* (Lepiota) *sistratus*, Fr. Ep. p. 18.

On sandy ground, M. Terry, Esq., Forres.

This pretty species is remarkable for the filamentous ring.

1186. *A.* (Lepiota) *delicatus*, Fr. Ep. p. 20.

About an old stump. Powerscourt, county Wicklow, Sept. 21, 1867.

Pileus hemispherical, obtuse, rivulose, viscid, smooth, pallid, 1 inch across; stem ½ inch high, ¼ thick, transversely punctate, squamulose, stuffed with flocci, white above; veil floccose, slightly appendiculate; gills free, rounded behind, approximate,

* The spores of this species and those of *A. cristatus* will be figured in a plate illustrating a subsequent communication.

pallid. The veil is really double, floccose, covered with scaly particles. Taste like that of *Polyporus squamosus*.

This is clearly a stout form of *A. delicatus*, of which we have a figure, from the author, closely corresponding with our species.

1187. *A.* (Armillaria) *denigritus*, Fr. in Mus. Suec. Pileo hemisphærico, obtuso, carnoso, fusco; carne albicante; stipite subæquali, solido, supra annulum amplum striato, candido; lamellis adnexis, fuscis.

On a grass-plot, near shrubs. Coed Coch, Mrs. Lloyd Wynne.

At first sight very like *A. Leveillei*; but the white spores at once distinguish it. We have an excellent drawing from Fries; but we are not aware whether at present he has given any characters.

1188. *A.* (Tricholoma) *ustalis*, Fr. Ep. p. 29.

Reigate, W. Wilson Saunders, Esq.

This and one or two other novelties are recorded on the authority of a beautiful set of drawings which have been submitted to us, some of which will shortly be published by Mr. W. G. Smith.

1189. *A.* (Tricholoma) *pessundatus*, Fr. Syst. Myc. i. p. 38.

In pine-woods. Street, Somerset, Aubrey Clarke, Esq.

1190. *A.* (Tricholoma) *colossus*, Fr. Ep. p. 38.

Under an elm. Batheaston, Oct. 11, 1869.

Var. Pileus about 4 inches across, irregularly lobed and undulated, minutely scaly, grey; stem about 2 inches high, thicker upward, buff, yellow at the base; gills rather wide, pallid. Smell strong, like that of cheese.

1191. *A.* (Tricholoma) *pravus*, Lasch in Linn. vol. iv. no. 532.

In a stove. Kew, July 1867.

1192. *A.* (Tricholoma) *cœlatus*, Fr. Ep. p. 42.

On the ground. C. E. Broome, Charmy Down, Ap. 29, 1867.

Spores subglobose, ·0003 long, ·00015 wide.

1193. *A.* (Tricholoma) *tigrinus*, Schæff. t. 89.

Reigate, W. Wilson Saunders, Esq.

1194. *A.* (Tricholoma) *acerbus*, Bull. t. 571. f. 2.

In woods. King's Cliffe, Wales, Lyndhurst.

1195. *A.* (Tricholoma) *brevipes*, Fr. Ep. p. 51; Bull. t. 521. f. 2.

Melton Mowbray, the Rev. H. H. Gillett, June 19, 1869.

1196. *A.* (Tricholoma) *sordidus*, Fr. Syst. Myc. vol. i. p. 51.

On the ground, amongst dung. Great Elm, Somerset, Sept. 21, 1866.

Spores pale ferruginous, ·0003 long.

1197. *A.* (Tricholoma) *lixivius*, Fr. Ep. p. 51.

In pine-woods. Ascot, Nov. 22, 1865.

1198. *A.* (Tricholoma) *putidus*, Fr. Ep. p. 54.

In fir-woods. A. Jerdon, Esq., Roxburghshire, Nov. 18, 1868; Ascot, Nov. 22, 1865. M. Terry, Esq., Forres.

1199. *A.* (Clitocybe) *nigrescens*, Lasch in Linn. vol. iv. No. 521.

In a larch-plantation, W. G. Smith.

1200. *A.* (Clitocybe) *tornatus*, Fr. Ep. p. 62.

Amongst grass at the foot of old decayed elm-stumps. North Kilworth, Leicestershire, Oct. 10, 1870.

*1200. *A.* (Clitocybe) *orbatus*, Fr., Bull. t. 248. f. *c.*

Ely, Nov. 12, 1870, W. Marshall, Esq.

1201. *A.* (Clitocybe) *membranaceus*, Fl. Dan. t. 1012; Fr. Ep. p. 68.

Street, Aubrey Clarke.

1202. *A.* (Clitocybe) *parilis*, Fr. Ep. p. 69.

By the side of plantations. Coed Coch, Mrs. Lloyd Wynne. Slightly hygrophanous, but not becoming white.

1203. *A.* (Clitocybe) *brumalis*, Fr. Syst. Myc. vol. i. p. 171.

In woods. Ascot, 1868.

1204. *A.* (Clitocybe) *ectypus*, Fr. Syst. Myc. vol. i. p. 108.

Roxburghshire, A. Jerdon, Esq.

1205. *A.* (Collybia) *distortus*, Fr. Ep. p. 84.

At the roots of trees. Bowood, Oct. 19, 1869, C. E. Broome.

**A. tuberosus*, Bull.

The summer form of this has no tuberous root; later in the year the tuber is formed, which produces its pileus the following season.

1206. *A.* (Collybia) *collinus*, Scop. Carn. p. 432.

On beech-stumps near Worthing, F. Currey, Esq., Oct. 1867.

1207. *A.* (Collybia) *coracinus*, Fr. Ep. p. 95.

Fir-plantations. Batheaston, Nov. 1865, C. E. Broome.

1208. *A.* (Collybia) *inolens*, Weinm. No. 183.

In woods. Street, Somersetshire, Aubrey Clarke, 1868.

1209. *A.* (Collybia) *plexipes*, Fr. Ep. p. 96; Fl. Dan. tab. 2023. fig. 2.

In woods, A. Jerdon, Esq. Melrose, Leigh Wood, Oct. 1868, C. E. Broome.

1210. *A.* (Collybia) *murinus*, Batsch, f. 19.

Marlborough Forest, Oct. 15, 1863, C. E. Broome.

1211. *A.* (Collybia) *clusilis*, Fr. Ep. p. 98.

b. minor.

Coed Coch, Oct. 1869.

1212. *A.* (Mycena) *cohærens*, A. & S. p. 163.
On bramble. Batheaston, Feb. 1869, C. E. Broome.
1213. *A.* (Mycena) *atro-cyaneus*, Batsch, f. 87.
On the ground. Ascot, Nov. 22, 1865.
1214. *A.* (Mycena) *ammoniacus*, Fr. Ep. p. 109.
On the ground. Lyndhurst, Oct. 22, 1868, C. E. Broome.
1215. *A.* (Mycena) *citrinellus*, Pers. Ic. et Desc. t. 11. f. 3.
On woods. Lucknam Grove, Oct. 15, 1867, C. E. Broome.
1216. *A.* (Mycena) *sacchariferus*, n. s. Albidus; pileo hemisphærico toto, stipite brevi filiformi lamellisque paucis crassiusculis granulis nitentibus obsitis.

On bramble- and nettle-stalks. March 1869, Batheaston.

Pileus 2 lines broad; stem 2 lines high, fixed at the base by a few flocci; gills 8–9, very distant, arcuato-decurrent, their margin and even the surface granulated.

Allied to *A. tenerrimus*, which has crystalline particles on the pileus, but the gills are free and ventricose.

1217. *A.* (Omphalia) *leucophyllus*, Fr. Mon. Hym. Suec. vol. i. p. 183.
Amongst short grass. Coed Coch, 1869.
1217 *bis*. *A.* (Omphalia) *rusticus*, Pers. Obs. i. tab. 4. f. 12.
On the ground. Sept. 7, 1866, Coed Coch.
1218. *A.* (Pleurotus) *spongiosus*, Lasch in Linn. vol. iv. No. 548.
Epping Forest, Oct. 12, 1869. On beech, Worthington G. Smith.
1219. *A.* (Pleurotus) *craspedius*, Fr. Syst. Myc. vol. i. p. 187.
On dead trunks, W. Wilson Saunders, Esq.
1220. *A.* (Pleurotus) *circinatus*, Fr. Ep. p. 132.
On dead wood, Worthington G. Smith.
Exhibited with *A. porrigens* at the Fungus Show, Oct. 5, 1870. W. W. Saunders.
1221. *A.* (Pleurotus) *mutilus*, Fr. Syst. p. 191.
On dead wood. Penzance, Dec. 1869, C. E. Broome, and J. Ralfs, Esq. Hastings.
1222. *A.* (Pleurotus) *porrigens*, P.
On dead fir. Inverary, Duke of Argyll.
1223. *A.* (Pleurotus) *petalodes*, Bull. t. 226, 557.
On railroad-sleepers, abundantly, Aubrey Clarke.
1224. *A.* (Entoloma) *jubatus*, Fr. Syst. Myc. vol. i. p. 196.
On lawns, W. G. Smith. Coed Coch, Mrs. Lloyd Wynne.
1225. *A.* (Leptonia) *lappula*, Fr. Ep. p. 152.
Forres, Rev. J. Keith.
1226. *A.* (Leptonia) *solstitialis*, Fr. Ep. p. 152.
Amongst stones by the side of Lake Ceneord, Aberdeenshire, Sept. 1870, with abundant specimens of *Lactarius pubescens*.

1227. *A.* (Leptonia) *lazulinus*, Fr. Ep. p. 153.
On the ground amongst grass. Aber, Sept. 30, 1867.

1228. *A.* (Nolanea) *verecundus*, Fr. Spic. p. 6.
Amongst short grass. Aber, Sept. 30, 1867.

1229. *A.* (Stropharia) *inunctus*, Fr. Pileo e campanulato convexo-plano, pellicula gelatinosa facile secernibili vestito; stipite deorsum attenuato candido, infra annulum floccoso-fibrilloso; lamellis latis, adnatis, fusco-subpurpureis.
On rich ground. Ely, W. Marshall. Sibbertoft.
Pileus 2 inches across, fleshy, livid; stem $2\frac{1}{2}$ inches high, $\frac{1}{4}$ thick, stuffed, composed of fibres; spores purplish brown, ·00028 long. Resembles some states of *A. æruginosus*; but the spores are of a different colour and much smaller.

1230. *A.* (Pholiota) *heteroclitus*, Fr. Obs. ii. p. 223.
On dead trunks. South of England.
A magnificent species, of which we have secured an excellent drawing.

1231. *A.* (Pholiota) *junonius*, Fr. Syst. Myc. vol. i. p. 244.
On the trunks of trees.
This interesting species has been discovered in this country by Mr. Cooke.

1232. *A.* (Pholiota) *confragosus*, Fr. Ep. p. 169.
On an old fallen elm. Coed Coch, 1866.
Spores oblong, ferruginous, ·0003 inch long by ·0015.

1233. *A.* (Inocybe) *phæocephalus*, Bull. t. 555. fig. 1.
Rev. W. Houghton, Preston, near Wellington, Oct. 1869.
We regret very much that we have seen only one small specimen of this species. The spores are bright ferruginous red; and, if we are correct in our determination, the species should be placed in the subgenus *Inocybe*.

1234. *A.* (Inocybe) *calamistratus*, Fr. Syst. Myc. vol. i. p. 256.
In fir-woods. Luggela, Wicklow, Sept. 1867.
Spores ·0005 long, smooth.
A noble species, remarkable for the blue colour of the base of the stem.

**A.* (Inocybe) *geophyllus*, var. *lateritius*.
This curious form, if it is really the same species, has been sent to us by Mr. Jerdon from Jedburgh. When dry, it retains its brick-red colour.

1235. *A.* (Inocybe) *scabellus*, Fr. Syst. Myc. vol. i. p. 259.
Amongst short grass. Little Ormes Head, Oct. 16, 1867.
Pileus chestnut, sericeo-squamulose; stem white, pruinose at the apex; gills ventricose, adnexed, ascending, pallid.

1236. *A.* (Hebeloma) *firmus*, Pers. (*A. clavus*, Batsch, f. 199).
In fir-woods. Gwrwch, Denbighshire, Sept. 4, 1866.

Pileus viscid, gibbous, smooth; taste not bitter, smell raphanoid; stem not attenuated, brown downwards and within; gills thin, slightly sinuated behind, cinnamon-brown; colour exactly as in Batsch's figure.

1237. *A.* (Hebeloma) *sinapizans*, Fr. Ep. p. 180.

W. Wilson Saunders.

1238. *A.* (Hebeloma) *elatus*, Batsch, f. 108.

W. Wilson Saunders.

1239. *A.* (Flammula) *helomorphus*, Fr. Ep. p. 184.

In fir-woods. Roxburghshire, A. Jerdon, Esq., Nov. 3, 1868.

Spores ·00015–·00025 long, pale brown.

1239 *bis.* *A.* (Flammula) *mixtus*, Fr. Ep. p. 185.

On the ground in pine-woods, C. E. Broome.

1240. *A.* (Flammula) *spumosus*, Fr. Ep. p. 185.

In woods. Epping Forest, W. G. Smith.

Spores ·0002 long.

1241. *A.* (Flammula) *decipiens*, Smith, in Seemann's Journ. 1869, p. 249, t. 95. figs. 5–8.

On burnt earth, Epping Forest.

Differs from *A. carbonarius* in the truly decurrent gills.

1242. *A.* (Flammula) *alnicola*, Fr. Syst. Myc. vol. i. p. 250.

On stumps of various trees, Mr. James English.

1243. *A.* (Flammula) *conissans*, Fr. Ep. p. 187; Bull. t. 178.

On dead stumps.

Often confounded with *A. fascicularis*, but with differently coloured gills and spores.

**A.* (Flammula) *hybridus*, Fr. Ep. p. 189.

On decayed wood of conifers. Lyndhurst, Oct. 16, 1868, C. E. Broome.

1244. *A.* (Flammula) *picreus*, Fr. Syst. Myc. vol. i. p. 239.

On the floor of Mr. Bull's orchard-house, Worthington G. Smith.

1245. *A.* (Flammula) *lubricus*, Fr. Syst. Myc. p. 252.

Tunbridge Wells.

1246. *A.* (Naucoria) *semiflexus*, B. & Br. Pileo hemisphærico, castaneo, hygrophano, margine velo subtili albo ornato; carne alba; stipite semihorizontali, solido; lamellis distantibus, adnexis, fulvis; sporis echinulatis.

On the side of a bank. Ascot, Oct. 30, 1867.

Pileus ½ inch across, subcampanulate, then hemispherical or flattened above, moderately fleshy; stem ¾ inch high, ⅔ line thick. Spores oblong, ·0003–·0004 long, ·00025–·0003 wide.

Allied to *A. horizontalis*.

1247. *A.* (Naucoria) *scolecinus*, Fr. Ep. p. 194.

On moist ground under alders in the Deer-Park, Powerscourt, county Wicklow, Sept. 1867.

Spores apiculate, ·0003 long by ·0013.

1248. *A.* (Naucoria) *tenax*, Fr. Syst. Myc. vol. i. p. 290.

With *A. crobulus.* Welford, Norths., Oct. 13, 1868.

1249. *A.* (Naucoria) *crobulus*, Fr. Syst. Myc. vol. i. p. 200.

In a ditch among fragments of sticks. Welford, Norths., Oct. 13, 1868.

1250. *A.* (Galera) *ovalis*, Fr. Ep. p. 236; Bull. t. 552. f. 1.

Amongst grass. Sibbertoft, 1868.

1251. *A.* (Galera) *antipus*, Lasch in Linn. vol. iv. No. 401.

On garden-pots, in the soil of which a good deal of sheeps' dung had been used. Sibbertoft, March 1870.

This species occurred during a month or more on different pots, but never in any large quantity.

Pileus campanulate, with a marginal veil; stem striate, pulverulent; base subterraneous, rooting, more or less bulbous. Spores rust-coloured, ·0006–·0007 long, ·00035 wide.

1252. *A.* (Galena) *rubiginosus*, P. Syn. p. 385.

Amongst moss. Kew Gardens, Sept. 1866.

1253. *A.* (Psalliota) *obturatus*, Fr. Syst. Myc. p. 285.

On the ground amongst grass. Kew. Melrose, A. Jerdon, Esq., 1868.

1254. *A.* (Psalliota) *melaspermus*, Bull. t. 540. fig. 1.

On the ground. Coed Coch, Oct. 19.

Requires to be carefully distinguished from *A. præcox*. Attention must be paid to the colour of the spores.

**A.* (Hypholoma) *lacrymabundus*, Fr. Syst. Myc. vol. i. p. 287.

A form or, rather, condition of this species occurred at Sibbertoft, in Sept. 1870, in which the broadly adnate gills remained permanently white. The edge was studded with beads of moisture, as in the more ordinary condition.

1255. *A.* (Psalliota) *merdarius*, Fr. Syst. Myc. vol. i. p. 291.

On dung. Sibbertoft, Oct. 28, 1870.

Densely gregarious. Pileus moist, prettily edged with the remains of the veil, $\frac{1}{2}$–1 inch across, stem $\frac{1}{2}$–$\frac{1}{3}$ inch high.

1256. *A.* (Hypholoma) *leucotephrus*, B. & Br. Cæspitosus; pileo primitus pallido, subcampanulato, rugoso, dein convexo-expanso, albido; stipite deorsum sericeo-fibrilloso, apice striato v. sulcato-striato, fistuloso, annulo amplo, hic illic appendiculato; lamellis angustis, primitus cinereo-albidis, leviter adnatis, dein e griseo nigris.

In large masses at the base of ash trees. North Kilworth, Oct. 10, 1870.

Pileus 3 inches across; stem 4 inches high, $\frac{5}{12}$ inch thick; gills $1\frac{1}{2}$ line broad. Spores ·00028 long, ·00019 wide, very dark brown purple.

This is clearly different from *A. Candollianus* and *A. appendiculatus*, Fr. The pileus is not of a rich brown when young, nor are the gills when old at all brown.

1257. *A.* (Psilocybe) *agnarius*, Fr. MSS. cum icone. Pileo e conico-convexo, expanso, albido, cinerascente, non hygrophano, subumbonato, subsulcato-striato; carne alba; stipite flexuoso, fistuloso, candido; lamellis valde distantibus, latiusculis, breviter adnatis adnexisve, cinereis.

About the roots of decayed trees. North Kilworth, Leicestershire, Oct. 10, 1870, and in other places, but not common.

Allied to *A. coprophilus*. In colour the pileus somewhat resembles *Hygrophorus ovinus*.

1258. *A.* (Panæolus) *acuminatus*, Fr., Batt. t. 22 F.

On dung. Sibbertoft, Oct. 1870.

Exactly according with Battara's figure, which scarcely agrees with the specific name.

1259. *A.* (Panæolus) *fimicola*, Fr. Syst. Myc. vol. i. p. 301.

On dung. A stouter form than that of Bolton. Sibbertoft, Oct. 1870.

1260. *A.* (Psathyrella) *subatratus*, Batsch, f. 89.

Batheaston, Sept. 1869.

1261. *A.* (Psathyrella) *caudatus*, Fr. Ep. p. 239.

Amongst the stumps of a wooden pavement, abundantly. Sibbertoft, Sept. 19, 1870.

A small form. Pileus at first sienna-brown, at length whitish, often transversely cracked; stem at first white, fibrillose; gills ventricose, adnate.

1262. *A.* (Psathyrella) *empyreumaticus*, n. s. Pileo expanso, hygrophano, atomato, e rufo pallescente; stipite elongato, sericeo-furfuraceo, pallido, eximie fistuloso; lamellis latis, crassis, distantibus, dente decurrente, adnatis, rufis, acie pallidis.

On a wooden pavement. Sibbertoft, Oct. 28, 1870.

Pileus $1\frac{1}{2}$ inch across, margin crenate; stem $2\frac{1}{2}$ inches high, $1\frac{1}{2}$ line thick, narrowly but distinctly fistulose; gills 2 lines broad, connected by veins, rufous, then brown-purple. Spores black.

Resembling *A. confragosus* so closely that, till the spores were observed, it was taken for that species.

[To be continued.]

XLIX.—*Remarks on the Animals lately described by Dr. Gray as* Testudo chilensis *and* Ateles Bartlettii. By P. L. Sclater, M.A., Ph.D., F.R.S., Secretary to the Zoological Society of London.

I am no lover of controversy; but taking, as I am bound to do, special interest in the correct determination of the animals that have lived in the gardens of the Zoological Society of London, I must ask the Editors of the 'Annals' to allow space for a few remarks upon the tortoise and spider monkey recently described by Dr. Gray in this journal, under the names *Testudo chilensis* and *Ateles Bartlettii*, female.

Testudo chilensis is described by Dr. Gray in the 'Annals' for August last (*anteà*, p. 190) as a "new Chilian" tortoise; but, in the first place, it is not new, and, in the second place, it is, as I believe, not Chilian.

That it is not new, but merely hitherto incorrectly determined, has been already admitted by Dr. Gray himself, in his second note on this subject (*anteà*, p. 428). This Tortoise was first discovered by D'Orbigny on the Rio Negro, in the south of the Argentine Republic, but referred by him and by Messrs. Duméril and Bibron (Erp. Gén. ii. p. 79) to *Testudo sulcata*, though the latter authors expressly notice the principal characters in which the single specimen examined differs from that African species*.

Burmeister, in the second volume of his 'La Plata-Reise,' also follows the determination of Duméril and Bibron, but gives us the additional information that this tortoise "is found near Mendoza, and all over the Pampas" (*l. c.* p. 521)†.

In his excellent essay on the geographical distribution of the Testudinata (Mém. Ac. St. Pét. 7th ser. vol. viii.), Dr. Strauch discusses at full length the alleged occurrence of *Testudo sulcata* in Africa and South America as an extraordinary exception to the general law of distribution of these animals, and comes to the conclusion that either the African tortoise has been introduced, by the agency of man, into South America, or, more probably, the American so-called *Testudo sulcata* belongs to a different species (*l. c.* pp. 23, 24).

So far, therefore, from the so-called "Chilian" tortoise being "new," it appears to have been known to four or five

* "Dans l'horizontalité un peu moins marquée des plaques dorsales, et dans la présence d'un petit bord tranchant le long des flancs qui sont au contraire arrondis chez les autres."

† Dr. Peters has most kindly obtained from the Museum of Halle and examined for me Burmeister's specimens, and has no doubt of their being not *Testudo sulcata*, but the so-called *T. chilensis*.

previous writers, including the authors of the 'Erpétologie Générale,' the most ordinary book of reference on the Reptilia.

Secondly, as to the locality of the two specimens of this tortoise received by the Zoological Society, upon one of which Dr. Gray has established his *Testudo chilensis*. It is true that they formed part of a large collection of living animals brought to England for sale from Santiago. But these were certainly not all natives of Chili; for instance, the Burmeister's Cariama (*Chunga Burmeisteri*), of which three specimens were in the collection, is confined to the provinces of Tucuman and Catamarca in the north of the Argentine Republic. Again, there were, besides the so-called *Testudo chilensis*, examples of two other tortoises in the collection, neither of which is Chilian—one (*Testudo elephantopus*) being probably from the Galapagos, and the other (*Geoclemmys annulata*) from the coast of Peru, or Ecuador*. Moreover it is expressly stated by all authorities on the subject that no species of tortoises at all are found in Chili †. Had any tortoise been more recently discovered in that country, I cannot doubt that the excellent naturalist Dr. R. A. Philippi, the director of the Museum of Santiago, who has contributed so largely to our knowledge of the Chilian fauna ‡, would have made the fact known. I have very little doubt, therefore, that the specimens received from Santiago, upon which the so-called *Testudo chilensis* has been established, were either obtained from the Argentine provinces on the opposite side of the Andes, along with the Burmeister's Cariamas, or, still more probably, from near Buenos Ayres, where the vessel which brought them touched on her way from Valparaiso. To make this point certain, I have written to Dr. Philippi, and shall, in the event of the answer confirming my belief that the tortoise is not found in Chili, propose to change its name to *Testudo argentina*.

* In his 'Supplement to the Catalogue of Shield Reptiles,' recently published (p. 29), Dr. Gray gives the "Gulf of Darien (*Salvin*)" as a second locality for this Terrapin. There must be some mistake here, as Mr. Salvin was never in his life in the Gulf of Darien. The specimen of *Geoclemmys annulata* brought home living by Mr. Salvin, in May 1863, and presented to the Zoological Society (which is probably what Dr. Gray refers to), was picked up by that gentleman himself at Huamuchal, in the Pacific-coast region of Guatemala. See this place as marked in Mr. Salvin's map accompanying Dr. Günther's paper, Trans. Zool. Soc. vi. pl. 53.

† Cf. *Guichenot*, in Gay's 'Historia Fisica y Politica de Chile,' ii. p. 8; *Bibra*, Denkschr. Akad. Wien, v. Abth. 2, p. 127; and *Strauch*, *l. s. c.* p. 27.

‡ See his numerous articles in Wiegmann's Archiv, of most of which a list is given in P. Z. S. 1867, p. 319.

I may add that the typical specimen of *Testudo chilensis*, Gray, now in the British Museum, has twenty-five marginal plates, and the same number is shown in a figure of this specimen prepared by Mr. Ford. Our living specimen, however, only possesses the normal number of twenty-three. Dr. Gray gives no dimensions in his description. Our living animal is 9·8 in. long, 7·7 broad, and 4·0 thick.

Next, as regards the spider monkey referred by Dr. Gray (*anteà*, p. 428) to the female of his *Ateles Bartlettii*. In the first place, *Ateles Bartlettii* (described and figured P.Z.S. 1867, p. 992, pl. xlvii.) is by no means a new species, being the same as *Ateles variegatus* of Wagner. Natterer discovered this finest of spider monkeys on the Serra de Cocoi, on the Upper Rio Negro, in 1831; and it was first shortly described by Wagner in 1840, in the supplementary notes to his first volume of Schreber's 'Säugethiere' (p. 313). Further details are given in one of Wagner's articles on South-American Mammals, in the 'Abhandlungen' of the Academy of Munich (v. p. 420); and the species is inserted in its proper place in the fifth or "Supplement-Band" to Wagner's 'Säugethiere,' the most ordinary book of reference on this Order of Mammals (*l. c.* p. 78).

Herr v. Pelzeln, of the Imperial Cabinet of Vienna, who has most kindly examined the typical specimens of this spider monkey for me, and agrees in considering them the same as *Ateles Bartlettii*, Gray, so far as he can tell from the figure and very short description* above referred to, informs me that Natterer obtained five examples of this animal—a male, three females, and a young. But as the females agree with the male in the yellow colour of the under surface, it follows that the spider monkey just described by Dr. Gray as resembling his *A. Bartlettii*, except in being "greyish white" where the *A. Bartlettii* is "bright yellow," cannot be the female of this species. Nor can it, I think, be the young of this spider monkey, as Herr v. Pelzeln informs me that the young individual of *A. variegatus*, in the Imperial Cabinet of Vienna, resembles the adult, except in the absence of the frontal spot and the white stripe on the sides of the face. At the same time the condition of the skeleton of the Society's specimen shows it to have been quite immature; and the length of the fur and other characters of this example agree so well with those of

* Herr v. Pelzeln observes that the under colour is rather too bright in the figure and that no dimensions are given. In two of Natterer's specimens, also, the yellow colour of the under body is continued over the upper surface of the limbs.

A. variegatus that I should be sorry to make a new species out of it without further evidence.

Dr. Gray gives no locality or other particulars concerning this specimen, simply stating that it has been "received" by the British Museum. I may therefore add that it was obtained by the Hon. A. Gordon, lately Governor of Trinidad, from the upper part of the Caura river, a southern confluent of the Orinoco, and presented alive to the Society's collection on the 14th of July last. It died on August 18th, and was sent to the British Museum.

L.—*Notulæ Lichenologicæ.* No. XXXIV.

By the Rev. W. A. Leighton, B.A., F.L.S., F.B.S. Ed.

Notes on the Chemical Reaction in the British species of Pertusaria.

In preparing my 'Lichen-Flora of Great Britain' I have had occasion to devote a good deal of attention to the genus *Pertusaria*, and have discovered that in no series of lichens do the chemical reagents give more important or more beneficial results. By their means we are not only enabled to define the limits of the species themselves, but also definitely and satisfactorily to allocate the forms comprised in the old pseudogenera of *Variolaria* and *Isidium*, which have ever proved a sort of *crux* to lichenists, and have consequently performed a continual migration from one genus to another. My proposed arrangement is as follows:—

A. *Thallus* K *yellow, then orange-red.*

1. *P. multipunctata* (Turn.), E. Bot. 2061. *Variolaria multipunctata*, T. & B.! Lich. Br. 73.
2. *P. Westringii* (Ach.). *P. lactescens*, Mudd!, Man. 272. *Isidium Westringii*, T. & B.! Lich. Brit. 93; E. Bot. 2204.
3. *P. glomerata* (Schleich.).
4. *P. ceuthocarpa* (Sm.), E. Bot. 2372. *Isidium microsticticum*, T. & B.! Lich. Br. 94.
5. *P. dealbata* (Ach.), E. Bot. 1541 & 1511. *Isidium paradoxum*! and *corallinum*! and *coccodes*! *a* & *β*, T. & B. Lich. Brit. 97, 100, 89. *Variolaria chlorothecia*, Tayl.! Fl. Hib. 2. *P. syncarpa*, Mudd!, Man. 273.

B. *Thallus* K *yellow*, C *yellow.*

6. *P. communis*, DC., E. Bot. 677; and forma *rupestris*, DC.

7. *P. dactylina* (Ach.), Fellm. 144. *Isidium*, Ach. Syn. 282.

C. *Thallus* K *yellow*, C *reddish orange.*

8. *P. bryontha* (Ach.), Th. M. Fr. 9; Fellm. 142; Arn. 108.
9. *P. melaleuca* (Sm.), E. Bot. 2461.
10. *P. fallax* (Pers.), E. Bot. 1731 & 1529. *Thelotrema hymeneum*, T. & B.! Lich. Br. 185. *Isidium lutescens*, T. & B.! *l. c.* p. 87.

D. *Thallus* K *yellow*, C *crimson.*

11. *P. gyrocheila*, Nyl. in Flora, 1865, p. 354.

E. *Thallus* K—, C *crimson.*

12. *P. velata* (Turn.), E. Bot. 2062. *Variolaria lactea*, T. & B.! Lich. Br. 69; E. Bot. 2410. *Variolaria aspergilla*, T. & B.! *l. c.* 67; E. Bot. 2401. *Variolaria conspurcata*, T. & B.! *l. c.* 55; E. Bot. 964. *Isidium coccodes β*, T. & B.! *l. c.* 89.

F. *Thallus* K—, C. *rose-colour.*

13. *P. faginea* (L.), E. Bot. 1713. *Variolaria*, T. & B.! *l. c.* 64. *Variolaria ilicea*, Lyell!, MS. in Herb. Borrer.

G. *Thallus* K—, C—.

14. *P. ophthalmiza*, Nyl.! Scand. 180. In Herb. Borrer at Kew is an Irish specimen labelled, in Dr. Taylor's handwriting, *P. constellata*, Tayl., which appears identical with this.
15. *P. globulifera* (Turn.), E. Bot. 2008 & 1714. *Variolaria*, T. & B.! *l. c.* 59. *Variolaria discoidea*, T. & B.! *l. c.* 61.
16. *P. Hutchinsiæ* (Turn. & Borr.), E. Bot. Suppl. 2652. *Thelotrema*, T. & B.! *l. c.* 178.
17. *P. glomulifera*, Borr.!, Leight. Ang. Lich. 30, t. 11. f. 2.
18. *P. pustulata* (Ach.), Leight. Ang. Lich. 30, t. 10. f. 4.
19. *P. leioplaca* (Ach.).
20. *P. nolens*, Nyl.! in Flora, 1864, p. 489.

H. *Thallus* K *brownish*, C —.

21. *P. fastigiata* (Turn. & Borr.). *Isidium oculatum β. fastigiatum*, T. & B.! *l. c.* p. 103. *Variolaria polythecia*, Tayl.! Fl. Hib. 2. 114.
22. *P. sublactea*, Leight., n. sp. *Variolaria lactea*, in Herb. Borrer!, and plant spoken of in T. & B. Lich. Brit. p. 72.

LI.—*List of Coleoptera received from Old Calabar, on the West Coast of Africa.* By ANDREW MURRAY, F.L.S.

[Continued from p. 413.]

MONOHAMMUS, Serv.

1. *Monohammus ruspator*, Fab. Syst. El. ii. 300.

M. nubifer, Schönh. Syn. Ins. iii. App. 165.

Nigro-piceus, opacus, dense umbrino-pubescens; thorace inæquali utrinque unispinoso; elytris fasciis duabus cinereis obliquis divergentibus obsoletis.
Long. 8–10 lin., lat. 3 lin.

Opaque, nigro-piceous, clothed with a dense umber-brown close pile. Thorax with a stout spine on each side. Elytra with two cinereous obliquely diverging fasciæ. The scutellar space usually darker brown than the rest, and always stopping short of and within the humeral angle.

I have come to the conclusion that Fabricius's *M. ruspator* and Schönherr's *M. nubifer* are the same species. It varies much in size, and somewhat in shade of colour, and in the markings; but their character is always the same.

The relations of the Old-Calabar *Monohammi* are to the Indian species, and not to the European and North-American, which differ from them somewhat in facies and more especially in texture. The genus is not represented in the Brazilian region, but is replaced by *Tæniotes*, *Ptychodes*, &c.

2. *Monohammus sparsutor*, Chevr. Rev. et Mag. d. Zool.

Cinereo-obscurus, in elytris nigro irroratus; capite sulcato, disperse punctato; antennis cinereis, longe obscuro maculatis; thorace inæquali, vage punctato, transverso, antice posticeque truncato, angusteque constricto, basi modice coarctato, spina laterali valida; scutello semirotundato, macula grisea signato; elytris punctato-striatis, thorace latioribus, humeris rectangulis, apice subtruncatis.
Long. $7\frac{1}{2}$ lin., lat. $2\frac{1}{2}$ lin.

Similar, so far as regards the colour and markings, to *M. irrorator* (posteà), but, as regards form, to the *M. ruspator* of Fabricius, only a little smaller, ash-coloured, and with only some scattered punctures on the head and thorax; on the first is a longitudinal groove. Mandibles and eyes black. Antennæ brownish black, ringed with ash-colour at the base of the articles, starting from the fourth. Thorax transverse, unequal, straight, and narrowly grooved transversely on the anterior

and posterior margins, with the base regularly constricted. Scutellum marked with a yellowish rounded patch. Elytra broader than the thorax, broad and little flattened, projecting and rectangular, on the shoulder, shortly truncate at the apex, marked with striæ formed of small punctures placed rather close to each other. Their surface is covered with little drops of blackish brown. Legs and underside of a uniform grey.

Described by M. Chevrolat from a specimen received by Mr. Hislop; but a specimen, named by him, which I have seems to me only a small variety of *M. ruspator*.

3. *Monohammus basalis*, Chevr. Rev. et Mag. d. Zool. 1857, p. 74.

Brunneo cinereoque variegatus; capite thoraceque (spina laterali valida) vage punctatis; palpis oculisque nigris; antennis nigris, longis (♀), robustis, fusco longe cinereoque breviter annulatis; scutello subquadrato, cinereo, intus depresso; elytris crebre punctatis, ad basin minute tuberculatis, ad apicem subtruncatis, fasciis duabus nigricantibus prima lata basali infra triangulariter protensa, secunda obliqua ultra medium.

Long. 9½–12 lin., lat. 3–3½ lin.

This species also closely resembles the *M. ruspator* of Fabricius. Its colour is obscure ashy, a little shining here and there. Head irregularly and sparsely punctate, and with a narrow longitudinal groove. Palpi, mandibles at the apex, and eyes black. Antennæ a little longer than the body (in the female), lightly clothed with a fine down below, with the first article black, scabrous and strongly margined at the apex, second small, third and fourth very long, brown, the remainder diminishing in length, and more or less ringed with ash-colour at their base. Thorax transverse, straight and grooved transversely along its anterior and posterior margins, with a very strong lateral spine, which is closely punctate; the disk and the sides are only sparsely punctate. Scutellum somewhat square, ash-coloured, depressed in the middle. Elytra of the breadth of the thorax at the tip of the spines, cut rectangularly on the shoulder, feebly attenuated behind, rounded on the exterior part of the apex, but truncated near the suture, which is unarmed; of an obscure ash-colour mixed with black, with two bands of the same colour; the first rests on the base, and extends as far as the shoulder and obliquely backwards to the suture; the second is narrow, behind the middle, and directed obliquely towards the suture; they are covered with a rather close punctation, which becomes slightly tubercular

on the basal band. Body below and legs of an ash-colour less obscure than above, marked by scattered distant punctures; middle tibiæ excised about the middle of the outer margin, and feebly pilose to the apex; tarsi of a more or less obscure ash-colour fringed by silken and golden hairs.

M. ruspator, Fab. (*nubifer*, Sch.), differs in having the basal dark-brown space triangular, and never occupying the shoulder; this has the whole base, shoulder included, of the brown colour. It is a larger species, and has longer and stronger antennæ.

One specimen. In my collection.

4. *Monohammus oculifrons*, Chevr. Rev. et Mag. d. Zool. 1856, p. 490.

Vage punctatus, fuscus; mandibulis, oculis et in vertice capitis quatuor maculis sericeis nigris; thorace antice uni- et postice bistricto, tuberculis duobus dorsalibus, spina laterali sat valida; elytris fasciis duabus obscuris, prima latissima e basi ad medium, sed secunda ultra medium.

Long. 10 lin., lat. 3½ lin.

This species would have been more correctly named had it been called *oculiocciput* instead of *oculifrons*, the black patches from which it is named being quite at the back of the head, so as to be almost concealed under the thorax when the head is bent back. It is of a brownish ash-colour, and marked by small distant punctures. Head strong, longitudinally sulcate in front, with four subocellate velvety black patches joined together posteriorly on the occiput. Labrum large, square. Clypeus transverse, pale ash-coloured. Antennæ entirely brown, scarcely longer than the body (in the female); first article elongated, swollen and nodulated at the apex. Thorax as long as broad, straight at the extremities, with three transverse grooves, of which the anterior is flexuous and the two at the base straight; it is bituberculate towards the disk near the anterior sides, depressed in the centre, and with a slight longitudinal keel. Scutellum semicircular, rather large. Elytra broadly rectangular, raised on the shoulder (with some small smooth tubercles), narrowly rounded at each extremity, and with two obscure bands, of which the first extends from the base to the middle, and the second, which is narrow, is beyond the middle. Middle tibiæ furnished on the outside with an emarginate tooth, and fringed up to the apex with a yellowish down. Five abdominal segments, first and fifth large.

Not common.

5. *Monohammus cordifer*, Chevr. Rev. et Mag. d. Zool. 1856, p. 490.

Parvus, minute et ordine punctatus, griseus; mandibulis apice, oculis maculaque subscutellari et cordiformi in elytris nigris; antennis longis, fuscis; elytris anguste truncatis, fasciola fusca ultra medium signatis.
Long. 4 lin., lat. 1½ lin.

Small, regularly and finely punctate, obscure ash-coloured. Head slightly inclined and longitudinally sulcate. Palpi brown, yellowish at the apex. Mandibles and eyes black. Antennæ once and a half the length of the body; the first article grey, and the following ferruginous. Thorax straight in front and behind, grooved on the anterior margin; lateral spine situated in the middle, tolerably strong and sharp. Scutellum semicircular, silky and ash-coloured. Elytra broader than the thorax, cut straight at the base, rectangular at the shoulder, parallel, narrowly truncate at the apex, marked with a black silky subcordiform patch behind the scutellum; an obscure obsolete transverse band which reaches to the margin is placed beyond the middle, and some small spots of the same colour are scattered here and there. Legs and body below of a uniform ashy-grey colour; middle tibiæ emarginate on the outer side, and clothed with a pale villous pubescence.

One specimen in my collection.

6. *Monohammus Thomsoni*, Chevr. Rev. et Mag. d. Zool. 1855, p. 184. Pl. II. fig. 4.

Affinis *M. Luscæ*, Fab. Vage punctatus, fuscus; mandibulis oculisque nigris; capite longitudinaliter sulcato; antennis pubescentibus, apice infuscatis; thorace transverso (cinereo breviter et dense piloso) antice posticeque recto, lateribus acute et valide spinoso; scutello albo; elytris cum macula communi magna scutellari alteraque laterali ampla virguliformi atro-holosericeis (fœmina).
Long. 9½ lin., lat. 3¼ lin.

Allied to *M. Luscæ*, Fab. Fuscous, irregularly punctate. Mandibles and eyes black. Antennæ pubescent, with the apex fuscous. Thorax densely covered with a cinereous pile, the sides armed with an acute and stout spine. Scutellum white. Elytra with a large, black, velvety, silky, scutellar patch common to both, and another large one on the sides.

Named by M. Chevrolat, in accordance with my wish, in honour of Mr. W. C. Thomson, at that time missionary at Old Calabar, now a medical practitioner in Liverpool, to whom

I am indebted for a very large number of the species received from Old Calabar.

7. *Monohammus irrorator*, Chevr. Rev. et Mag. d. Zool. 1855, p. 517.

Alatus, elongatus, vage punctatus, nigro cinereoque vestitus; antennis (cinereo annulatis) tibiisque partim ferrugineis; thorace antice posticeque recte truncato, ad basin late sulcato, spina laterali valida; elytris thorace multo latioribus (humeris rectangulis), in apice obtuse truncatis, striato-punctatis, cinereis nigro irroratis et fere trifasciatis.
Long. 8 lin., lat. 2½ lin.

Of the size of *M. ruspator*, Fab., but somewhat narrower and proportionally more elongate. Body ash-coloured, covered with black spots and patches. Head with only some scattered punctures, blackish ash-coloured behind, and with a triangular black patch on its occipital part and an elongated one on each side facing the eyes. Longitudinal channel very narrow. Palpi brown, yellowish at the apex of the articles. Mandibles black, rugose at the base, smooth at the tip. Eyes black. Antennæ ferruginous, ash-coloured at the base of the articles, starting from the fourth: first article obscure, punctate. Thorax almost as long as broad, truncate, rather broadly grooved at the base; its disk has three small blackish convexities with some scattered punctures; the lateral spine is broad and thickened at the base. Scutellum broad, semicircular, ash-coloured, with a large black rounded spot. Elytra three times the length of the thorax, broader than it, projecting and truncate rectangularly at the shoulder, subtruncate at the apex, punctate-striate, the punctures transversely tubercular on their front, near the base, as if impressed from behind; the ground-colour is ashy, and covered with black spots which are more or less confluent, forming as it were three transverse bands. Body below uniform ash-coloured. Thighs arched, ferruginous; tarsi ashy ferruginous.

Only one or two specimens.

8. *Monohammus viridipennis*, Chevr. Rev. et Mag. d. Zool. 1855, p. 284.

Opacus, nigro-plumbeus, pube albida indutus; capite in longitudinem arcte sulcato, antice bifoveolato; articulis palporum apice luteis; antennis nigris, corpore vix longioribus; thorace antice posticeque recto et marginato, transversim tristricto, vix punctato, spina laterali valida, brevi; scutello

semirotundato, nigro nitido; elytris punctato-striatis, plus minusve viridibus (fœmina).

Long. 7½ lin., lat. 2½ lin.

Opaque, leaden black, with a whitish pubescence. Head sharply longitudinally sulcate, bifoveolate in front. Antennæ black, scarcely longer than the body. Thorax transversely thrice constricted, scarcely punctate, with a strong short lateral spine. Scutellum semirotundate, black, shining. Elytra distinctly punctate-striate, in some specimens more or less green, in others of the general lead-colour, sometimes faintly obliquely clouded.

In my collection.

PACHYSTOLA, Reiche, Voy. en Abyss. p. 393.

1. *Pachystola annulicornis*, Chevr. Rev. et Mag. d. Zool. 1855, p. 184. Pl. III. fig. 5.

Cinereo-glauca; capite antice cervino, postice fusco variegato, longitudine sulcato, mandibulis oculisque nigris; antennis nigris, cum tertio articulo apice quartoque basi cervinis; thorace transverso, antice posticeque (bistricto) recto, lateribus breviter unispinoso, fusco irrorato, vittis tribus glaucis; scutello magno, semirotundato; elytris remote et subseriatim punctatis, glaucinis, cum macula magna scutellari vittaque laterali arcuata, intus ramosa, fuscis; corpore infra cinerascente, lateribus abdominis fusco maculatis.

Long. 12 lin., lat. 4 lin.

The excellent figure by M. Migneaux renders it unnecessary to add any thing to the above rubric, except that the light parts are cinereous or glaucous and the dark parts fuscous.

Several specimens received from the neighbourhood of Creek Town.

This genus, it is scarcely necessary to say, has nothing to do with *Lamia textor*, although that species stands as the first species under a genus of this name in Dejean's Catalogue.

2. *Pachystola arcuata*, Chevr. Rev. et Mag. d. Zool. 1855, p. 184.

Fusca; mandibulis oculisque nigris; capite truncato, inter oculos angusto et inter antennas angulosim emarginato; antennis crassis, apice acutis; thorace transverso, inæqualiter plicato, lateribus late et acute spinoso; elytris cum maculis duabus brunneis, prima decussata (e scutello ad medium marginem), secunda laterali (infra humerum) et ubique grosse punctata; vitta alba pectorali.

Long. 11 lin., lat. 3¼ lin.

Fuscous; mandibles and eyes black. Thorax unequally plicate. Elytra with two brown patches: the first decussate, from the scutellum to the middle of the margin; the second lateral, below the shoulder, and everywhere coarsely punctate. Underside with a white pectoral stripe.

Several specimens.

3. *Pachystola decussata*, Chevr. Rev. et Mag. d. Zool. 1856, p. 530.

Brunnea; vittis duabus in thorace (prima laterali, secunda infra lata post oculos), in elytris vittis duabus decussatis, magnam literam X formantibus, tertiaque parte apicali suturæ, femoribus posticis ad apicem maculis duabus corporeque infra (medio excepto) albidis; mandibulis, clypeo et oculis amplis nigris; antennis validis, corpore brevioribus, articulo ultimo acuto.

Long. 16 lin., lat. 5 lin.

Brown. Head convex on the forehead, truncated obliquely below, marked behind with five lines and with a longitudinal narrow channel which borders the eyes. Mandibles brilliant black. Labrum pilose, square. Clypeus very narrow, transverse. Eyes large, slightly emarginate above, black. Antennæ hardly reaching more than two-thirds of the length of the body, tolerably thick, with the last article acuminate. Thorax straight in front and behind, marked with three transverse channels; four white longitudinal dorsal tubercles two lines in length, the first on the side, and the second below, facing the eye; lateral spine very stout and sharp. Scutellum semicircular. Elytra broader than the thorax, raised on the shoulder, and depressed within it, parallel and rounded towards the apex of the suture, which is slightly angular; they have two white bands crossed in the form of an X, and of which each starts obliquely from the shoulder to the middle of the suture, and thence proceeds backwards obliquely to the margin, which it reaches at the level of the apex of the posterior thigh; at that place it bends back in a semicircle towards the extremity, and remounts on the suture, where it terminates below the union of the lines. Legs and middle of the body of an ashy brown. Breast and abdomen broadly margined with white; posterior thighs with two white patches at the apex; abdomen with five segments, the last large, broadly truncate above, emarginate in the middle, and longitudinally channelled beneath.

One specimen.

4. *Pachystola ligata*.

Fusca; capite, fronte et clypeo pube grisea (versus oculos

dilutiore) vestitis, postice medio atque pone oculos vitta brevi albida vestito, macula subbrunnea vel derasa pone angulos oculorum et supra et subtus; thorace supra vittis tribus, una media dorsali, alteris utrinque ad latera et margine basali albidis; pectore pube grisea vestito, vitta laterali albida utrinque instructo; elytris vittis albidis, bis decussatis; antennis articulo tertio macula parva postica ad basin et breviter ad apicem, articulo quarto breviter ad basin albidis: subtus albido-grisea.

Long. 7½ lin., lat. 3 lin.

Brown; entirely clothed with dark-brown pubescence. Head with front and clypeus brownish griseous, turning paler and yellowish white next the eyes, and also on their posterior margins, except at the upper and under angles. Eyes coarsely granular, emarginate, and very nearly meeting on the top of the head; back of the head with a groove and a whitish stripe, the sides obliquely white. Antennæ as long as the body, with a whitish mark at the back of the base of the third article, the top of which and the base of the fourth are also whitish, the remaining articles lighter brown than the basal articles. Thorax with a stout tubercular spine on each side; the disk raised, but without the furrows and raised spaces so characteristic of the other species of *Pachystola* and *Prosopocera*, or, if present, they are concealed by the pubescence; basal margin plicate and pale, a longitudinal narrow dorsal stripe and a broader pale stripe on the sides; beyond this, the sides below are griseous, and then another whitish stripe. Scutellum palish brown, with a whitish line in the middle and along the sides. Elytra sparingly punctate, most strongly towards the base, with a decussate whitish pattern; a stripe starts from the base between the scutellum and the shoulder, runs obliquely backwards to the margin, reaching it about the middle of the elytra, and becoming wider as it goes backwards; about a fourth of the length of the elytra from the base this stripe sends off a branch towards the suture, which it reaches before the middle; it then turns obliquely towards the margin, which it reaches at about a fourth from the apex; on reaching the margin, it divides, one narrow fringe running round the apex to the sutural angle, the other trends obliquely across to the suture, which it reaches a short distance from the apex, and continues down to the sutural angle, there joining the marginal line. Underside and legs clothed with yellowish white; the upperside of the last two tarsi brown.

Unique. In my collection.

[To be continued.]

BIBLIOGRAPHICAL NOTICE.

1. *Preliminary Field-Report of the United-States Geological Survey of Colorado and New Mexico, conducted, under the authority of the Secretary of the Interior, by* F. V. Hayden, United-States Geologist. With *a Report on the Mines and Minerals of Colorado, by* Persifor Frazer, junior; and *a Report on the Agriculture of Colorado, by* Cyrus Thomas. 8vo, pp. 155. Washington, 1869.
2. *Geological Report of the Exploration of the Yellowstone and Missouri Rivers, by* Dr. F. V. Hayden, *under the direction* of Captain W. F. Raynolds, Eng. 1859–60. With *Report on the Cretaceous and Tertiary Plants, by* J. S. Newberry, M.D. 8vo, pp. 174. Washington, 1869. With a Geological Map.
3. *The Lifted and Subsided Rocks of America, with their Influences on the Oceanic, Atmospheric, and Land Currents, and the Distribution of Races.* By George Catlin. 8vo, pp. 228. London, 1870.

The United States Secretary of the Interior reported last year that Congress had appropriated $10,000 for the continuance of the Geological Survey of the Territories of the United States by Professor Hayden, and that he was instructed by the Department of the Interior to direct his attention especially to the geological, mineralogical, and agricultural resources of the Territories of Colorado and New Mexico, to ascertain the age, order of succession, relative position, dip, and comparative thickness of the different strata and geological formations, and to examine with care all the beds, veins, and other deposits of ores, coals, clays, marls, peat, and other mineral substances, as well as the fossil remains of the different formations. He entered on his labours in the field the last day of June 1869, at Cheyenne, Wyoming Territory. His route was through Denver, the silver- and gold-mining region of Georgetown and Central City, the Middle Park, Colorado City, and Fort Union to Santa Fé, returning through the San-Luis valley and South Park to Denver. The exploration, though brief and rapid, was eminently successful; and the collections in geology, mineralogy, botany, and zoology were extensive. His preliminary report bears date October 15th. It is accompanied by two other reports made to him by his assistants—one on mines and mining, the other on agriculture. These papers, the Secretary of the Interior remarks, are valuable contributions to our knowledge of the subjects they embrace, and merit careful perusal; and certainly we fully agree with him, even if we take this Field-report of Colorado and New Mexico by itself; and their value is more fully seen when studied together with Dr. Hayden's Report on the Exploration of the Yellowstone and Missouri Rivers, and other reports on Kansas, Nebraska, &c., by United-States geologists.

The Colorado Territory, between 37° and 41° N. lat. and 102° and 109° W. long., almost equally divided into highlands, on both slopes of the Rocky Mountains (reaching 13,000 feet above the sea), and

flats of the "Great Plains," is nearly 110,000 square miles in extent, nearly equalling the area of Great Britain and Ireland. It has already a vast system of railroads,—three passing across from the Atlantic to the Pacific, and others radiating from Denver in every direction. New Mexico, lying on the south, continues the physical features of Colorado, together with the extensive and thick lignites (of great economic value), with "the valuable ores that abound almost everywhere in the granite and gneiss of the Rocky Mountains," with the grand line of water-springs along their base, and a "healthful and delightful climate." On the plains the geological structure is very simple (chiefly horizontal Tertiary beds); but frequently over large areas the basal rocks are concealed by superficial deposits. The upheaved ridges ("hog-backs") on the eastern base of the Rocky Mountains expose the geology of the country. "Often in a little belt, from half a mile to four or five miles in width, one may travel over the upturned edges of nearly all the formations in the geological scale; and the opportunity was presented, in this way, for tracing out their relations by studying the junction of the changed with the unchanged rocks." Indeed to the geologist Colorado is almost encyclopædic in its character, as indeed the magnificent report, by Ives and Newberry (1861), on the Colorado of the west prepared us to believe. Besides the gold- and silver-mines, the mines of coal (mainly Tertiary) and iron (of different ages), especially along the base of the mountains, were examined by the surveyors; and those of the Raton Hills are likely to be "of far more value to the country than all the mines of precious metals in that district."

Mr. P. Frazer reports on the metallic (iron, copper, zinc, lead, silver, gold) and other minerals, including turquoise, coal, albertite, &c., and notices most of the chief lodes and mines that are being worked, also the oil-wells and the medicinal and salt springs. Respecting the geological relations of the lodes of Colorado, the structure of the Rocky Mountains there, and their denudation, Dr. Hayden offers the following interesting and thoughtful remarks:—

"The gold- and silver-lodes of this Territory, so far as they are observed, are entirely composed of the gneissic and granite rocks, possibly rocks of the age of the Laurentian series of Canada. At any rate, all the gold-bearing rocks about Central City are most distinctly gneissic, while those containing silver at Georgetown are both gneissic and granitic. The mountain in which the Baker, Brown, Coin, Terrible, and some other rich lodes are located is composed mostly of gneissic and reddish feldspathic granite, while the Leavenworth and M'Clellan Mountains, equally rich in silver, are composed of banded gneiss, with the lines of bedding or stratification very distinct.

"There is an important question that suggests itself to one attempting to study the mines of Colorado; and that is, the cause of the wonderful parallelism of the lodes—the greater portion of them taking one general direction or strike, north-east and south-west. We must at once regard the cause as deep-seated and general; for

we find that most of the veins or lodes are true fissures, and do not diminish in richness as they are sunk deeper into the earth. All these lodes have more or less clearly defined walls; and some of them are quite remarkable for their smoothness and regularity. We assume the position that the filling-up of all these lodes or veins with mineral matter was an event subsequent to any change that may have occurred in the country rock. Now, if we look carefully at all the azoic rocks in this region, we shall find, more or less distinctly defined, depending upon the structure of the rock itself, two planes of cleavage, one of them with a strike north-east and south-west, and the other south-east and north-west. Beside these two sets of cleavage-planes, there are in most cases distinct lines of bedding. The question arises, what relation do these veins hold to these lines of cleavage? Is it not possible that they occupy these cleavage-openings as lines of greatest weakness?

"I have taken the direction of these two sets of cleavage-planes many times with a compass, over a large area; and very seldom do they diverge to any great extent from these two directions, north-east and south-west, or south-east and north-west. In some instances the north-west and south-east plane would flex around so as to strike north and south, and the other one so as to trend east and west; but this is quite seldom, and never occurs unless there has been some marked disturbance of the rocks. There are, however, a few lodes which are called 'east and west lodes,' and some 'north and south.' A few have a strike north-west and south-east, but are generally very narrow, and break off from the north-east and south-west lodes, are very rich for a time, and then 'pinch' out. It would seem, therefore, quite possible that the north-east and south-west veins took the lines of cleavage in that direction as lines of greatest weakness, and that the north-west and south-east lines cross the other set, and that a portion of the mineral material might accumulate in that cleavage-fissure. I merely throw out this as a hint at this time, which I wish to follow out in my future studies. I am inclined to believe that the problem of the history of the Rocky-Mountain ranges is closely connected with these two great sets of cleavage-lines. As I have before stated, my own observations point to the conclusion that the general strike of the metamorphic ranges of mountains is north-west and south-east, and that the eruptive trend north-east and south-west. The dykes, that sometimes extend long distances across the plains, in all cases trend north-east and south-west, or occasionally east and west. The purely eruptive ranges of the northern portion of the San-Luis valley seem to be composed of a series of minor ranges *en échelon*, with a trend north-east and south-west. But as soon as this range joins on to a range with a metamorphic or granitic nucleus, the trend changes around to north-west and south-east. Many of the ranges have a nucleus of metamorphic rocks, though the central and highest portions may be composed of eruptive peaks and ridges. In this case the igneous material is thrust up in lines of the same direction as the trend. It becomes, therefore, evident that all the operations of the

eruptive forces were an event subsequent to the elevation of the metamorphic nucleus. This is shown in hundreds of instances in Southern Colorado and New Mexico, where the eruptive material is oftentimes forced out over the metamorphic rocks, concealing them over large areas.

"All over the mining-districts are well-marked anticlinal, synclinal, and what I have called 'monoclinal' valleys. Nearly all the little streams flow, a portion or all their way, through these monoclinal valleys or rifts. In most cases the stream passes along the rift from source to mouth, but occasionally bursts through the upheaved ridges at right angles, resuming its course again in some monoclinal opening. There are a few instances of these streams flowing along anticlinal valleys; and by any one these remarks will be at once understood by studying the myriad little branches of Clear Creek or South Platte, which flow for long distances through the mining-districts.

"In these valleys are oftentimes accumulated immense deposits of modern drift. Sometimes there are proofs that these valleys have been gorged for a time, and a bed of very coarse gravel and boulders will accumulate, hundreds of feet in thickness. Near Georgetown there is a fine example of this modern drift-action.

"It would seem that the valley of that branch of Clear Creek in which the Brown and Terrible silver-lodes are located was gorged at one time, perhaps, with masses of ice, and the fine sand and coarse materials accumulated against the gorge, and at a subsequent period the creek wore a new channel through this material. The upper side of this drift-deposit is fine sand, but the materials grow coarser as we descend, until, at the lower side, there are immense irregular or partially worn masses of granite. On the sides of the valley the rocks are often much smoothed and grooved as if by floating masses of ice. We assume the position, of which there is most ample evidence all over the Rocky-Mountain region, that at a comparatively modern geological period the temperature was very much lower than at present, admitting of the accumulation of vast bodies of ice on the summits of the mountains. The valley of the South Platte, as that stream flows through the range east of the South Park, shows not only these accumulations of very coarse boulder-drift, but when this drift is stripped off, the underlying rocks are found smoothed, and in some instances scratched, as if by floating icebergs."

Dr. Hayden regards the lignites (often passing into good coal) of these territories as of Tertiary age (mostly Lower; some, of little value, in the Middle Tertiary); they constitute "from 10,000 to 20,000 square miles of mineral fuel in the centre of a region where for a radius of 600 to 1000 miles in every direction there is little or no fuel either on or beneath the surface;" and if these coals can be made useful for smelting the iron-ore abounding on all sides, and now reduced with charcoal, "the future value of these deposits cannot be over-estimated" in exerting "the same kind of influence over

the progress of the West that Pennsylvania exerts over all the contiguous States." The fossil flora of these Lignites (represented by collections made by Drs. Hayden and Leconte, and determined by Professor Lesquereux in 1868) is enumerated at pages 95–97; and respecting their *Tertiary* age, Dr. Hayden says, at p. 97:—

"In conclusion, I beg leave to say that, while I have the most profound respect for the labours of my fellow geologists in the same field, I differ with them somewhat, simply because the evidence, to my mind, points in a different direction. In various portions of the Laramie Plains, Colorado, Raton Hills, &c., I have observed between the well-defined Cretaceous and Tertiary beds a group of strata, composed of thin layers of clay, with yellow and grey sands and sandstones, which I have called transition or beds of passage. If in these beds I were to find some purely marine remains, even *Inoceramus* or *Baculites*, I should then call them transition beds, in accordance with the evidence of the continuous uninterrupted growth of the continent from the Cretaceous through the Tertiary period. There is no proof, so far as I have observed, in all the western country, of true nonconformity between the Cretaceous and Lower Tertiary beds, and no evidence of any change in sediments or any catastrophe sufficient to account for the sudden and apparently complete destruction of organic life at the close of the Cretaceous period. In all my examinations of the coal-formations over so vast an area, I have never yet seen a trace of a Cretaceous fossil in any strata above the coal."

Of the widely spread Tertiary deposits stretching along the eastern side of the Rocky Mountains, and mainly consisting of limited, though grand, lacustrine accumulations, but possibly here and there defined anew by denudation, Dr. Hayden enumerates many local groups, which it is impossible at present to collate in detail. Of these, arranged provisionally, there are, belonging to the *Upper Tertiary*, the:—

Salt-Lake group (1000 to 1200 feet of sandstones and marls); Bridger group (upward continuation of the Green-River group); Arkansas marls and Santa-Fé marls; and the Loup-River group, with remains of "wolves, foxes, tigers, hyenas, camels, horses, mastodons, elephants, &c."

To the *Middle Tertiary* belong the:—

Echo-Cañon group, 3000 to 5000 feet thick, including conglomerates from 1500 to 2000 feet thick; Wasatch group, reddish and variegated sands and clays, west of the Bridger group; Green-River shales, containing asphaltic shales, with fishes, insects, &c., and next below the Bridger group; Washekee group, with impure lignite; Gallisteo sands, with silicified wood, overlying the Placer-Mountain group; Monument-Creek group; White-River group (with Upper Tertiaries on it), covering at least 150,000 square miles, "remarkable as one of the most wonderful deposits of extinct mammalia on the globe," and of purely freshwater origin *; and the Wind-River group, of limited extent.

* See Ann. & Mag. Nat. Hist. ser. 3. vol. xi. pp. 376, 377.

To the *Lower Tertiary* belong the :—

Bear-River group, with coal-beds 26 feet thick at Evanston (p. 91); Placer-Mountain group, with coal, thirty miles south of Santa Fé, New Mexico; Raton-Hills group, with coal; Cañon-City group, with coal; Judith-River group; and, lastly, the Fort-Union or Great Lignite group, of which probably the Placer-Mountain, Raton-Hills, and Cañon-City groups are fragments; whilst those of Bear River, Judith River, and perhaps other places, were independent lacustrine formations*.

In the 'Annals,' ser. 3. vol. xi. (1862), we have already given an abstract view of the geology and natural history of the Upper Missouri (a continuation northwards of the geology of New Mexico and Colorado), founded on Dr. Hayden's researches (with Dr. Meek and others) in 1857–60, published in his Report of 1862; and we have now before us a fuller account (published in 1869) of some of the researches there referred to, namely those carried out in company with Capt. (now Lt.-Col.) Raynolds, in 1859–60, on the Yellowstone and Missouri Rivers, and by the author on the Niobara and White Rivers, and some remarks on the Dakota Territory. A special feature in this report (pages v–ix) is the careful historical account of earlier labours in this grand geological field of North-western America, extending from 42° to 49° North lat., and between 98° and 114° W. long. The geological notes on some parts of the Dakota (from Yancton to Sioux Falls and the Pipestone Quarry) were made in 1866. The country consists of the Lower Cretaceous rocks of that region resting on Carboniferous, with perhaps some Triassic strata between. The famous Catlinite, or Red Pipestone, is included in quartzites that belong to a supra-Carboniferous formation, but whether Triassic or Lower Cretaceous Dr. Hayden does not feel competent to declare.

In Dr. Newberry's Report on the Cretaceous and Tertiary Plants, we have an eloquent exordium on the growth and scientific value of geology, and its power in elucidating the physical geography of the North-American continent, and on the gradual accretion of the Palæozoic, Mesozoic, and Cænozoic strata to the old territorial nucleus, with especial reference to the floras of the successive periods, as illustrated by the fossil plants brought down to sea and lake, and left in their accumulating deposits. In speaking of the Cretaceous formations, covering so large a part of the North-western American region under notice, Dr. Newberry writes :—"The *Cretaceous period* has left behind it a grand series of monuments on this continent, from which may be read all the more important facts of its history. In some localities the strata of that age attained a thickness of 3000 or 4000 feet, and they now occupy more of the surface of the continent than those of any other formation. The era of the deposition of these strata was one of continental subsidence, in which the area of dry land was, especially at the west, greatly reduced. In the region east of the Mississippi the change of level was comparatively

* Ann. Nat. Hist. *loc. cit.*

slight, and resulted in the addition of but a narrow margin of Cretaceous rock, much of which has doubtless been cut away by the waves of the Atlantic, extending from Martha's Vineyard around our Atlantic and Gulf-coast to Mexico. The north-eastern portion of the continent seems not to have shared in this depression, as no Cretaceous rocks have yet been found there. West of the Mississippi, however, a broad area extends from the Arctic Sea to Mexico, and having a width of a thousand miles or more, which had previously been dry land and covered with forests, was gradually invaded by the sea, sunk beneath its waters, and for the most part deeply covered by its calcareous deposits. . . . Suffice it to say that over a great part of the area I have described the Lower Cretaceous strata, which correspond in age with the Gault of England, are coarse, thick-bedded sandstones and conglomerates, which everywhere contain the impressions of broad-leaved dicotyledonous trees, and in many instances beds of lignite, sometimes fifty feet in thickness. These are generally somewhat irregular, as though of drifted materials. The lithological characters of this member of the series, as well as its fossils, prove that it is composed of the immediate débris of the land, and it was gradually submerged beneath the ocean—sand, gravel, leaves, trunks of trees, &c.,—and is, in fact, simply an unbroken series of sea-beaches.

"These coarser beds are followed, in the ascending series, by strata of more or less pure limestone, highly charged with characteristic Cretaceous Mollusks (*Inoceramus*, *Ammonites*, *Baculites*, &c.), the natural accumulation from the waters of the ocean, and forming a marked contrast with the mechanical sediments and terrestrial fossils of the underlying beds.

"That the encroachment of the ocean was from the east and south towards the Rocky Mountains is proved by the fact that as we go from Texas and Arkansas in that direction, we find the limestones becoming less pure, containing more inorganic material (sand and clay), until in New Mexico and Colorado but little true limestone exists in the whole formation.

"During this submergence there was oceanic communication between the Gulf of Mexico and the Arctic Sea, as the Cretaceous strata stretch in unbroken sheets from Texas northward to and through the British Possessions. All the eastern half of the continent was, however, out of water, for we find no Cretaceous rocks deposited upon it; and the same is true of a considerable portion of the far west. In California the Cretaceous beds reach but little way up the flanks of the Sierra Nevada, and in some portions of the Rocky-Mountain country no traces of these rocks can be found.

"The Plants to which I have referred as forming the characteristic fossils of the Lower Cretaceous beds are of special interest, as they open a new chapter in the botanical history of the world. Although the region which furnishes them has been but partially surveyed, and collections made under the most unfavourable circumstances, already fully fifty species of forest-trees are represented in these

collections, and fragments obtained of at least as many more. The character of the vegetation which they reveal is that of a fertile surface and of a temperate climate, a vegetation, indeed, similar to that which now grows over the greater portion of the United States.

"A fact of still greater interest is that we here find representatives of quite a number of the most characteristic genera of our present forest, viz. *Liriodendron, Magnolia, Sassafras, Platanus, Fagus, Populus,* &c. So modern is the aspect of this flora, that it is not surprising that, when submitted to the fossil botanists of the Old World, it was by them pronounced to be of Tertiary age. A portion of this flora is represented in the figures and descriptions which follow*; and a much larger number of fossil plants from this horizon, collected by myself or others in New Jersey, Kansas, New Mexico, Colorado, Utah, and Vancouver's Island, are now in my hands, and others still have been described by Heer and Lesquereux; all of which confirm the statements which I have heretofore published in regard to our Cretaceous flora, viz.: 'That on this continent vegetation was revolutionized at the close of the Triassic period, when the Cycadaceous flora, which then prevailed on the earth's surface, was succeeded by the "reign of Angiosperms" in the introduction of a hundred or more species of forest-trees, in great part belonging to the genera now living in the temperate portions of our country.' From that early period the aspects of our flora do not seem to have materially changed, showing a stability and constancy in the physical conditions which prevailed here, such as is not indicated by the facts observed in other countries.

"Of the flora of the Upper Cretaceous strata we have, as yet, but a very imperfect view, from the facts before stated:—that over the greater portion of the area now underlain by Cretaceous rocks the sea existed during all the later ages of the period; and it was only here and there that land-plants continued to grow on shores that were subsequently submerged so that they could be buried and preserved. In the districts I have examined in Colorado, Utah, and New Mexico, shore-lines continued to exist to the close of the Cretaceous period; and there I have found, in the shales, sandstones, and lignites, at several levels, traces of plants which grew at a period later than those.... derived from the Lower Cretaceous beds. From this it is evident that the vegetation of the continent experienced no very marked change throughout the Cretaceous period. Many genera found in the lower beds recur in higher ones, while the new species seem to belong to genera largely represented in the Tertiary flora, which is still more allied to that of the present day. It is probable, however, that we shall find that by the contraction of the land-surface the climate of the remaining portion of the continent became more insular in character, and was thus capable of supporting a vegetation more characteristic of a lower latitude.

"*Tertiary Period.*—After the deposition of the Upper Cretaceous strata (such as correspond with the White Chalk of England), the

[* **Not published with this Report.**]

sea retreated from the area it had invaded at the commencement of the Cretaceous period; and this retreat would seem to have been considerably rapid, from the fact that over most of the area covered by the Cretaceous sea we find no evidence of the deposition of the strata corresponding in age to those of the first and lowest division of the Tertiary, the Eocene. In the region east of the Mississippi, on the shores of the Gulf and Atlantic, the Eocene beds form a conspicuous member of the Tertiary series; but in the far west they have not yet been recognized. The Miocene strata occupy a large area in the far west; but, except in California, where they compose a great part of the coast-mountains and cover the base of the Sierra Nevada, they are altogether of freshwater origin. In the area of the Great Basin, between the Sierra Nevada and the Rocky Mountains, these lacustrine deposits are largely developed; and in the region of the plains they extend in a series of local basins from the north line of Texas far up into the British Possessions.

"Conclusive evidence of the progressive elevation of this portion of our Continent is afforded by the observations of Dr. Hayden, who found the lower beds of some of these freshwater deposits containing estuary shells, oysters, &c., showing that at this period salt water had access to them. Subsequently further elevation prevented the influx of the sea, and they were filled with a succession of freshwater sediments. During this elevation, the arm of the sea, which, in the Cretaceous and early Tertiary ages, extended up the valley of the Mississippi to and beyond the mouth of the Ohio, gradually contracted, and the Tertiary beds were left as parallel belts of deposit from its waters, covering a V-shaped area along the lower Mississippi, including the eastern portion of Arkansas, the State of Louisiana, the western and southern portions of the State of Mississippi, and thence reaching around along the coast up on to the Atlantic shore. In the Miocene epoch, therefore, our continent had nearly the outlines which it exhibits at the present time, and the topography of the eastern portion remained almost unchanged. At the west, however, great changes took place, particularly marked by the elevation of most of the great mountain-chains which traverse that region. It should be borne in mind, however, that, as has been before stated, these mountain-chains have been represented by lines of elevation from the earliest geological periods, and in subsequent oscillations of level they seem to have acted simply as hinges or joints, upon which the plates of the continent turned.

"These mountain-masses were not wholly submerged during the Silurian period; but the Carboniferous sea swept over nearly all parts of them. In the great Cretaceous subsidence they were but partly covered; and since then they, with the tablelands which they crown, have remained far above the sea and the general level of the continent, and, exposed to atmospheric erosion during all subsequent ages, now exhibit the most striking evidences of the potency of this agent to be found upon the earth's surface.

"From the freshwater Miocene Tertiaries to which I have referred, Dr. F. V. Hayden has obtained a magnificent series of fossil plants,

and from these and the overlying Pliocene beds a still more interesting collection of the remains of vertebrate animals. . . . As a whole, the flora which the plants represent is strikingly like that of the Lower Miocene of Europe, which has been so amply illustrated in the beautiful work of Professor Heer, several species being identical, and the generic correspondence remarkably close. It will be noticed, however, that there is here an entire absence of the Indo-Australian plants which give character to the flora of the Eocene and, to a certain degree, to that of the Miocene of Europe. On the contrary, we have a grouping of plants which is closely copied by the flora of our Southern States at the present day. The great fan-palms which Dr. Hayden discovered are the only plants in the collection which have a tropical look; but these are associated with poplars, sycamores, hazelnut, mulberry, &c., which are very significant of a temperate climate, while, so far as yet observed, the tropical element in the Miocene flora of Europe, formed by *Cinnamomum*, *Hakea*, *Dyandra*, &c., is here entirely wanting.

"In the Cretaceous rocks of Vancouver's Island and the Tertiaries of Bellingham Bay, species of *Cinnamomum* have been found, as also in the Eocene deposits of the Mississippi valley, and the Eocene lignites of Brandon, Vermont—fossils which are indicative of a warmer climate than that which now prevails at these points; so that we have evidence that during the Cretaceous period the climate of [the region of] Vancouver's Island was warmer than that of the interior of the continent—and that during the Eocene period the climate of the eastern half of the continent was warmer than now, corresponding in some degree to the tropical climate which prevailed in Europe during the same epoch.

"In the collection of fossil plants recently described by Professor Heer, from Disco Island, off the west coast of Greenland, under the parallel of 70°, he finds *Sequoia Langsdorfii*, *Quercus Olafseni*, *Corylus Macquarrii*, and *Rhamnus Eridani*, which are characteristic of the Miocene of Europe, with a *Salisburia*,—all showing that during this period a climate equally mild with that of our middle States prevailed so far north. With this fact before us, and that of the discovery in Iceland of a similar flora which includes a *Liriodendron* scarcely distinguishable from our own, we are led to expect to find in the Miocene of the central portion of our continent a flora of a decidedly tropical character. Such, however, has not been the case, and the plants collected by Dr. Hayden on the Upper Missouri, as well as those derived from the Miocene strata of Bellingham Bay, Birch Bay, &c., on the north-west coast, unmistakably indicate a climate but a few degrees warmer than that of the present day.

"From the Pliocene beds of the Upper Missouri we have as yet obtained no plants; but the interesting series of vertebrate remains collected by Dr. Hayden, to which reference has been made, comes partly from the Miocene and partly from the Pliocene strata. These represent a fauna very different from any thing now living on this continent, showing that our plants have experienced far less changes than our animals. This fauna includes *Elephas*, *Mastodon*, *Rhino-*

ceros (three species), and a great variety of ruminants, rodents, carnivores, &c., forming more than sixty species, many of them of large size. Such a grouping of animals might be considered indicative of a warmer climate than the present; but the associated plants contain some living species, and are all closely allied to our present flora. Of the freshwater shells found in these beds the same may be said; and the plants obtained from California and the valley of the Mississippi, from strata which correspond very closely in age with those containing the Pliocene vertebrates, include a still larger number of living species.

"We have every reason to believe, therefore, that during the Miocene and Pliocene Tertiary periods the form and climate of our continent were similar to what they now are, that, while the climate was a little warmer, the aspects of nature were not greatly different from the present, and that the isothermal lines were curved across the continent very much as now. This is indicated by the flora on the north-west coast, which includes several of Dr. Hayden's Upper-Missouri species, and yet with them some which he did not find, and such as are indicative of a somewhat warmer climate.

"*The Drift Period.*—Having such an approach to the present condition of our continent during the later Tertiary ages, when many of our living species of both animals and plants were introduced, we have been very slow to accept the evidence which the glacial epoch furnishes us of a revolution in the physical geography of our country, scarcely less in degree than that recorded by any portion of the geological history. It would be foreign to my purpose to discuss here all the phenomena of the Drift Period; and it will be sufficient to give conclusions without the proofs upon which they rest, merely remarking that these conclusions are now generally accepted by those who have had the best opportunity of observing the facts. They are in general terms as follows:—

"First. That during the Drift Period a great depression of temperature took place over our continent, and that, at a corresponding period in the chain of events (whether synchronous or not), a similar cold period occurred in the Old World.

"Second. That during the prevalence of this cold term ice covered the greater part of the hemisphere down to the parallel of 38° or 40°, and covered the summits of our western mountain-ranges down to the northern line of Mexico and Arizona. South of these limits we have no proof of the existence of glaciers; and if they had existed, they would have been sure to leave their traces behind them. During this cold interval the fauna and flora of the northern portion of our continent must have been driven southward many degrees below their previous and present range.

"Third. After a longer or shorter period of continuance, the climate again changed, the temperature was elevated, the ice was melted, the glaciers withdrawn to Greenland on the one side and to the northern portions of the Rocky Mountains on the other.

"Fourth. By the melting of the accumulated snow and ice, the central portions of the continent were flooded, and the basin of the

great lakes was filled by an unbroken sheet of fresh water. From this were deposited the oldest Drift materials, stratified clays and fine sands, which rest upon the glacial surface. Upon these clays are found beds of boulders and masses of transported rock derived from the far north, which must have been floated southward on the surface of this inland sea, and dropped upon the fine and stratified sediments that covered its bottom.

"It is also evident that during the ice-period the northern portion of our continent was considerably elevated, as the channels of all the draining streams were then deeply excavated (to be subsequently partially filled with sand, gravel, &c.), and are now traversed by streams which in some instances are flowing 100 or 200 feet above their ancient beds. During this interval the deeply eroded trough of the Hudson, the channel of the Mississippi, the mouth of the Columbia, and the Golden Gate must have been excavated.

"This elevation was perhaps sufficient cause for the increase of cold; for it was doubtless attended by a great expansion of our continental surface toward the north, which would be a further source of cold. The elevated portion would serve as a condenser, and, with the temperature below 32°, would arrest and accumulate the precipitation which now forms the great streams which drain the northern half of our continent.

"The period of the melting of the ice was one of depression, as on the Atlantic coast it was followed by the deposition of Drift clays, which reach high above the present ocean level. This depression was perhaps in itself sufficient to restore the climate to its previous standard.

"The few fossils found in the Drift deposits of the interior of the continent are the remains of coniferous trees of species which now live throughout its northern portions (balsam, fir, red cedar, white pine, &c.), while on the Atlantic coast the Drift clays contain large numbers of marine mollusks; and these, as might have been expected, are arctic or subarctic in character.

"As to the effect produced by the cold period upon animal and vegetable life, it would seem probable that many of the larger vertebrates which lived on our continent during the Pliocene age were destroyed by it, as very few of them still exist; but in regard to our plants the observations made on the Pliocene flora seem to prove that nearly all the species of that period are still living and in the same localities; so that it would seem certain that the life-destroying power of the cold period was limited to those portions of the continent lying north of the 38th parallel. That the pre-existent flora and fauna were driven southward, and suffered a narrowing of their range, is unquestionable; and this was perhaps fatal to the largest of our land animals; but it had little effect on the flora and molluscous fauna, which are found to be essentially the same that they were before the Glacial epoch.

"On the whole the effect of the ice-period was highly beneficial to the portions of our continent most affected by it, as all the asperities of the surface were ground down and diminished, while the

depressions were more or less filled, and the whole covered with comminuted materials which, spread smoothly over the underlying rocks, formed a surface particularly favourable for cultivation."

Turning from the systematic, exact, and well-applied geology of the United States surveyors to the vague and dogmatic, uneducated and pretentious elaboration of an amateur's attempt at explanation and correlation of the grand geological phenomena of the western hemisphere, we take up, in Mr. G. Catlin's 'Lifted and Subsided Rocks of America,' a budget of as imperfect observations, erroneous impressions, false conclusions, and baseless fantasies as were ever put together in a so-called geological book. The only point of interest is the reference to subterranean streams of water in the Rocky-Mountain district; but far other means than crude notions, picked up casually in travel, and shaped by a little book-reading, must be used to indicate their unseen courses and lighten their obscure histories, whether they come out in the Pacific or the Atlantic, in both or in neither.

MISCELLANEOUS.

Land-*Planariæ*.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—In the September Number of the 'Annals of Natural History' (page 255) I observe a notice of two species of Land-*Planariæ* from Borneo, by the Rev. W. Houghton, who inquires regarding the occurrence of similar forms elsewhere. It may interest Mr. Houghton to know that I described a similar species, occurring at Madras in the cold season, under the name of *Planaria lunata*, which was of larger size and had no transverse stripes on the back.

I cannot give an exact reference to the volume of the 'Madras Journal of Literature and Science' in which the description occurs*; but, if Mr. Houghton desires, I will do so on my return home, and may perhaps even be able to find a loose copy of the paper itself for him. I remain, Gentlemen, yours &c.,

Walter Elliot, F.L.S.

Edinburgh, Nov. 11, 1870.

* I am now able to add the reference:—Madras Journ. of Lit. and Sc. vol. xv. (1848) p. 162, pl. 1.

Walfelee, Nov. 26th.

Notes on the Genus Myoictis. By Dr. J. E. Gray, F.R.S.

I described this genus in the 'Proceedings of the Zoological Society' for 1858, from a small animal which Mr. Wallace found in the Island of Aru, where it lives in houses and is as destructive as rats to every thing eatable.

The British Museum received from Mr. Franks, as coming from the Leyden Museum, in 1868, a much larger animal, under the name of "*Myodictus Thorbeckii*," "*Guilolo*, Salawati." On comparison of the two animals, it is evidently the adult state of the

animal discovered in the Aru Islands by Mr. Wallace; it chiefly differs from his specimen in the colours being brighter and more distinctly defined, the parts which are rufous in the young being dark red-bay in the adult.

Prof. Schlegel, in the 'Nederl. Tijdschr. Dierk.' vol. iii., describes the adult animal under the name of *Phascogalea Thorbeckiana*, and refers to the younger one as *P. Wallacei* (Gray). (See Record Zool. iii. p. 43.)

The examination of the skull of the adult animal shows that the skull described and figured in the Proc. Zool. Soc. 1858, p. 112, tab. 64, is that of an animal with milk-teeth, while the teeth of the adult skull are very like those of *Phascogale* and *Antechinus*: they agree with the teeth of *Antechinus apicalis* in the third false grinder on each side being much smaller than the preceding teeth; but it differs from both these genera in not having any small third false grinder in the lower jaw; the true grinders in both jaws are more like those of *Antechinus* than *Phascogale*.

The synonymy of the species will be:—

Myoictis Wallacii, Gray, Proc. Zool. Soc. 1858, p. 112, t. 64; Cat. Mam. N. Guinea in B. M. 1859, p. 11. figs. 1–4 (young).

Phascogale Wallacei (Gray); Schlegel, Nederl. Tijdschr. Dierk. iii. (1866) p. 355.

Phascogalea Thorbeckiana, Schlegel, Nederl. Tijdschr. Dierk. iii. (1866) p. 257; Zool. Record, iii. p. 43.

Inhabits Aru (*Wallace*), Island of Salawattie (*Schlegel*).

On a new Locality for Trocheta subviridis.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,—In February 1869 I published my identification of certain leeches sent to me for examination from the neighbourhood of Horsham; and in May of the same year Mr. Gedge mentioned, in the 'Annals,' having found in his note-book a memorandum of some having been sent to him, in the preceding January, from the same locality. I have now the pleasure of recording my having found this leech in the ditches of the Beddington sewage-irrigation farm of the town of Croydon.

The experiences of naturalists have differed as to the capability of *Trocheta* of living for any length of time in water. It may be interesting therefore to mention that I found my specimens entirely immersed in and crawling on the bottom of the great ditch through which the Croydon sewage passes before it flows over the land; and one of them is now alive in a bowl of water at the British Museum, where it has been four weeks, with the exception of a few hours spent in an envelope in my pocket. I am told that these leeches are also abundant on the other sewage farm belonging to the town of Croydon at Norwood.

I am, Gentlemen,
Your obedient Servant,
HENRY LEE.

The Waldrons, Croydon.
Nov. 19, 1870.

On the Motory Phenomena of Animal Cells. By N. Lieberkühn.

M. Lieberkühn's memoir contains numerous observations upon the obscure phenomena of intracellular life. It is difficult to arrange them in a single whole, although they relate without exception to a common subject. The following is a sketch of the principal facts.

Schwann had already been struck by the resemblance of the tissue of the *chorda dorsalis* to that of vegetable cells. This comparison has since been confirmed. The fundamental chondrogenous substance of the chorda dorsalis corresponds to the cellulose envelope of the vegetable cell; the masses of protoplasm adhering to the inner wall of the capsule sometimes exhibit movements and contractions such as we are acquainted with in the cells of plants; this protoplasm contains a liquid homologous with the liquid of the vegetable cell, across which filaments of granular protoplasm capable of changes of form are often stretched. The nuclei are applied against the wall. At a later period of development the granular protoplasm disappears, and there remains only a frothy substance, which at last disappears in its turn. Some very small granules which are sometimes found in the cellular liquid show by their molecular movement that they are situated in a very fluid medium; and their movement of progression proves the existence of determinate currents in this liquid.

A large portion of M. Lieberkühn's researches bear upon the relations of the cellular liquid and the protoplasm in the *Spongillæ*. These two elements may separate from each other to such an extent as to give origin to a sort of froth, in which small vacuoles may unite to form larger ones. Sometimes we even find one large vacuole in each cell. In this case these contain a transparent liquid, and the nucleus is always placed in the protoplasm surrounding it. The protoplasm may extend amœboid pseudopodia in various directions. This separation of the protoplasm and cellular liquid may in its turn disappear completely; or only a few small vacuoles may remain in the protoplasm of the cell, and then these vacuoles suddenly contract like the contractile vesicles of the Infusoria. Notwithstanding assertions to the contrary, M. Lieberkühn maintains the opinion that the contractile substance of the *Spongillæ* is formed entirely by the aggregation of independent cells; this he demonstrates by bringing a *Spongilla* to a temperature of about 140° F. The cells are then seen to contract and separate from each other in small isolated masses, each furnished with a nucleus. The cells of *Spongilla*, like the tissue of the chorda dorsalis, are able, in certain cases, to reproduce the plan of vegetable cells. This is what occurs during the formation of the siliceous parts of the envelope of the gemmules. Thus, at the surface of the soft protoplasm of the cells, a firm envelope of spongine is secreted; and this finally persists alone with the siliceous body formed in its interior, whilst the protoplasm becomes atrophied. It is certain that the vacuoles of the cells of *Spongilla* are filled with a liquid of very small density; for the gra-

nules which penetrate it enter upon molecular movements in the same way as in the vacuoles of the cells of the chorda dorsalis.

Phenomena very similar to those described in the cells of the *Spongillæ* have been observed by M. Lieberkühn in the colourless corpuscles of the blood of the salamanders and tritons. In the course of a single day one of these corpuscles may acquire a frothy appearance in consequence of the abundance of its vacuoles, or unite the whole of the cellular liquid in one large vacuole, round which the contractile substance with its nucleus is arranged like a thick membrane. Even in this form the colourless blood-corpuscle may execute movements and envelope red corpuscles, exactly as the *Amœbæ*, or a *Monas amyli*, or an *Actinophrys* will swallow foreign bodies.

Analogous phenomena also take place in the pigment-cells of the skin of the tadpoles of frogs and toads. Here also we find large vacuoles holding in suspension pigment-granules, which move about rapidly; and the cell may present amœboid movements.

In all the cases just enumerated it is important that we should not confound vital phenomena with those which are not vital. Molecular movements are now-a-days justly regarded as having nothing to do with life, but it is generally supposed that the amœboid movements of cells are a vital phenomenon. M. Lieberkühn rejects this notion as erroneous, and shows, by observations made upon the gemmules of sponges, that dead cells may manifest amœboid movements. When a little glycerine or common salt is added to the water in which a *Spongilla* is living, the body of the *Spongilla* contracts energetically, loses its transparency, and all vital manifestations cease entirely, never to reappear. If a gemmule be crushed in glycerine, the cells escape from it as a mass of perfectly motionless granules. These cells are certainly dead, and quite incapable of being developed like the cells of a gemmule crushed in water. And nevertheless these dead cells present amœboid movements as soon as a little water is added to the glycerine. On the other hand, a dead cell has never yet been seen to envelope another, as a colourless blood-corpuscle will envelope a red one.—*Schriften der Ges. zur Beförd. der gesammten Naturw. zu Marburg*, Band ix. 1870); *Bibl. Univ.* October 14, 1870, *Bull. Sci.* pp. 158–160.

On the Reptilia of the Triassic Formations of the Atlantic Region of the United States. By Prof. Cope.

Prof. Cope made some observations on the Reptilia of the Triassic formations of the Atlantic region of the United States. He observed that thirteen species had been described and referred to ten genera. None of these had been referred by their describers to their appropriate orders, and he had undertaken an investigation of them, having for its object such reference, as well as the determination of the closer affinities.

Three of the species he proved to be Dinosauria. He had already assigned *Megadactylus* and *Bathygnathus* to this division, and would now add *Clepsysaurus*, Lee, from evidence derived from an ischium

discovered among the original remains. It resembled that of *Megadactylus.*

Of the remaining ten species, he was satisfied that those referred to *Palæosaurus* by Emmons, as well as the *Compsosaurus* and *Eurydorus*, were founded on the posterior teeth of Belodonts. He also said that nothing was to be found in the descriptions of *Rhytidodon*, Emmons, and *Omosaurus*, Leidy, to distinguish them from *Belodon*, to which genus he was inclined to refer the remains which had fallen under his observation. Thus three species were certainly to be distinguished from the ten, viz. :—*Belodon carolinensis*, Emm. (*Rhytidodon*, Emm., ? *Centemodon sulcatus*, Lea); *Belodon priscus*, Leidy (*Palæosaurus carolinensis*, Emm., ? *Compsosaurus priscus*, Leidy, *Clepsysaurus pennsylvanicus* in part, Emmons); *Belodon Leaii*, Emmons (*Clepsysaurus*, Lea). The above were not asserted to belong to the same genus without doubt, but that evidence to distinguish them was yet wanting. He added a fourth species, discovered by Chas. M. Wheatley in the Triassic tracks of Phœnixville, Pennsylvania, which was apparently distinct from the above, and of larger size. The remains preserved were dorsal, lumbar, and caudal vertebræ, with costal and abdominal ribs; left femur and fibula, nearly perfect; portion of pelvis; ungueal and chevron bones, &c. The femur measured 13 inches in length, and the lumbar vertebræ exhibited slender cylindric diapophyses, which bore ribs to the sacrum. This reptile was named *Belodon lepturus*, and was estimated to have attained a length of about 12 feet.

Eleven of the thirteen species being thus disposed of, there remained the *Dicynodon rosmarus*, Cope, and *Rhabdopelix longispinis*, Cope. The latter he had formerly suspected to be a Pterosaurian, but he thought it more likely that it would turn out to be a Rhynchocephalian reptile.

He called attention to four remarkable vertebræ from the Cretaceous greensand of New Jersey, which were characterized by the possession of enormous pneumatic foramina. The articular extremities were rugose, and with scarcely any dense layer, so that they probably belonged to an immature animal, and were to be referred to the sacral or the lumbar region. If they belonged to the latter, they indicated a coossification similar to that seen in many birds. That they were not dorsal is indicated by the lack of capitular articulations. The pneumatic foramina occupied half of the centrum, along its middle, leaving abutments fore and aft for the support of the neural arch, which was lost in each one. There were no diapophyses. The neural canal presented a deepening and compression at the middle of the centrum, and a rising and expansion near the articulations. Centra much compressed mesially, as well as contracted upwards; articular extremity subtriangular, with rounded angles and notch for neural canal one-third its vertical diameter. Cancellous tissue coarse, but much finer than in *Lælaps*; the dense layer thin. The total length of the four is $17\frac{1}{2}$ inches, the shortest measuring 4, the other three $4\frac{1}{2}$ inches in length. The complete number of six would have measured 26 inches in length.

These vertebræ had been described as the sacrals of a young *Hadrosaurus* by Leidy (Cretaceous Reptiles of U. S. p. 100); but there are several reasons for dissenting from this conclusion. The pneumatic foramina of the sacral nerves, which, however, in known reptiles and birds, issue *between* the neural arches, not beneath them, not only in the sacral, but in the lumbar and other vertebræ. The reasons for questioning their pertinence to *Hadrosaurus* were:—first, the genus *Megadactylus* presents similar large pneumatic foramina, and they occur in both the caudal and lumbar vertebræ; the lumbar and caudal vertebræ of two species of *Hadrosaurus* are known, and do not present any pneumatic foramina whatever, which would scarcely be the case were the present vertebræ sacrals of *Hadrosaurus*. Second, they form too long a series for the known ilium of *Hadrosaurus*. From the approximation of the facets for the sacral diapophyses in the type specimens of *H. Foulkei*, it would appear that those vertebræ had somewhat the shortened form of the caudals; yet the present animal appears to be a young one. Third, the structure is in several respects more Megalosaurian than Iguanodontine. Thus the alternate enlargement and contraction of the neural canal is seen in *Palæosaurus* and *Clepsysaurus*; the neural arches appear to have alternated above the articulations of the centra. The pneumatic foramina exist in *Lælaps*, but of reduced dimensions.

In respect to the presence of the foramina just mentioned there is a resemblance to the *Ornithopsis Hulkei*, recently discovered by Seeley, though here the comparison ends. In that form the cancellous texture of the centrum is extremely open and light, and composed "of enormous honeycomb-like cells of irregular polygonal form—for the most part long in the direction of the length of the centrum, and divided by exceedingly thin and compact films of bone," &c. The structure in the subject of the above description is spongy and light, but much closer. *Lælaps* offers a much closer resemblance to *Ornithopsis* in its exceedingly coarse structure; while in *Megadactylus* the lumbar vertebræ appear to be absolutely hollow.

Had Mr. Seeley been acquainted with these genera, he would probably have referred *Ornithopsis* to the Goniopod Dinosauria rather than to the Ornithosauria. Prof. Cope added that he had already (Aug. 1869) published the view that the bone described previously as a quadratum of Iguanodon (the type of Seeley's *Ornithopsis*) was evidently not a cranial bone, but that he had always supposed it to be a vertebra.

The reptile represented by the above vertebræ was named *Pneumatoarthrus peloreus*, the possibility of its being found to be *Ornithotarsus* being entertained, though the near resemblance of the bones to those of a tortoise could not be overlooked. The specimens were discovered by Dr. John H. Slack, in Monmouth Co., N. J.—*Proc. Amer. Phil. Soc.* vol. xi. No. 84.

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